OPERATING AND SERVICE MANUAL

TM-8200-1

8200 CALIBRATION INDICATOR

TM-8200-1

BLH ELECTRONICS, INC.
A subsidiary of Baldwin • Lima • Hamilton Corporation
WALTHAM, MASSACHUSETTS 02154 • (617) 894-6700

TM-8200-1

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BLH MANUAL CHANGES

MODEL 8000, 8000ST, 8000SW, 8100, 8200

MANUAL TITLE All 8000 Series Transducer and Calibration Indicator Manuals

MANUAL PREFIX TM-8000ST-2, 8000SW-1, 8100-2, 8200-1

MAKE ALL CHANGES IN THIS MANUAL ACCORDING TO ERRATA AND CHANGE(S) LISTED BELOW

CHANGE:

All BLH 8000 Series Instruments manufactured after 1 October 1972 include internal RFI and EMI filtering capacitors. C2, C3, C4, and C5 (470pF) from TB1-1, TB1-4, TB1-5, and TB1-6, respectively, to Ground, have been installed at the rear of TB1. See Figure below.

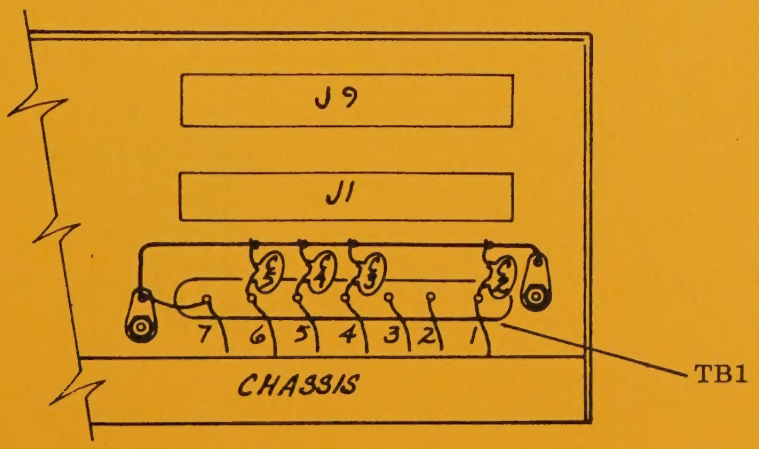
Section VI, Table 6-1, Replaceable Parts, Page 6-2. Add under Reference Designation A1:

A1A1C2-C5 or A1C2-C5 (8100 and 8200), BLH pn 142001-8, Quantity-4, C: 470 pF.

MP8 (8000, 8000ST), MP7 (8000SW), MP9 (8100, 8200), BLH pn 129055-8, Quantity-2, Lug #6.

Replace TB1 on the fold-out schematic diagram at the rear of the manual with the proper Figure on the following page (2) of this Errata. TM-8100-2 fold-out schematic has been changed prior to this notice.

REAR PANEL - INSIDE VIEW



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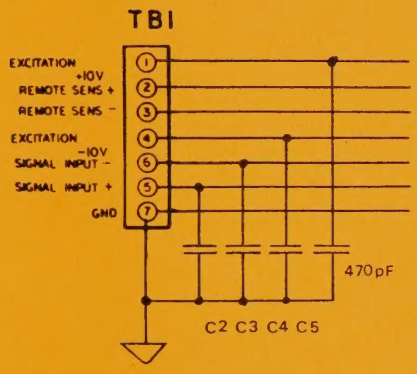
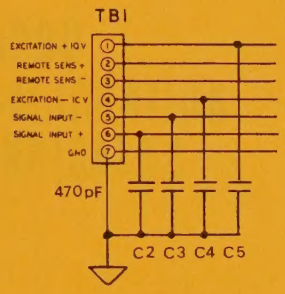
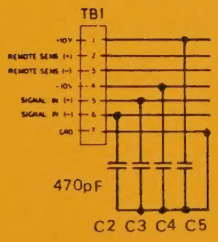
8000 - 8000ST



8000SW



8200



OPERATING AND SERVICE MANUAL

8200
CALIBRATION
INDICATOR

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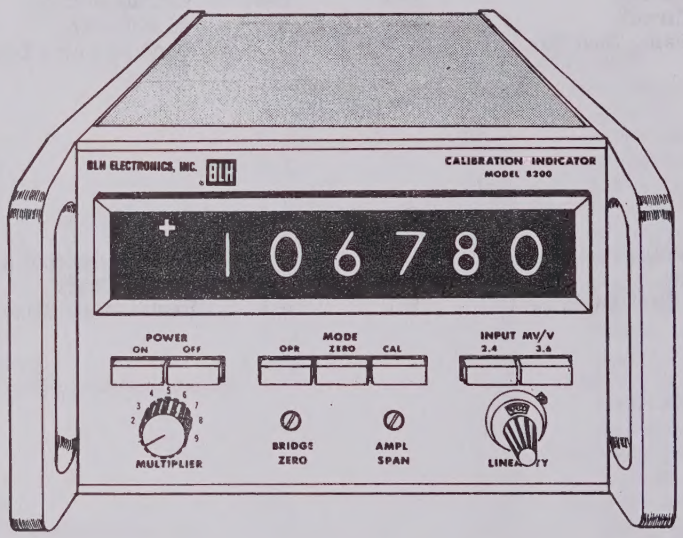


Figure 1-1. Model 8200 Calibration Indicator

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. Purpose and Scope.

1-3. This manual contains the basic installation, calibration, operation, and maintenance instructions for the BLH Model 8200 Calibration Indicator. This information is supplemented by individual service manuals for the transducer being used with the Indicator.

1-4. DESCRIPTION.

1-5. The Model 8200, Figure 1-1, is essentially a solid-state digital voltmeter designed for use with a 120 - ohm or 350-ohm high accuracy calibration load cell. The combination of Indicator and load cell, properly calibrated, provides an accurate means of checking and calibrating load and force measuring systems involving tension and/or compression loads.

1-6. The millivolt-per-volt signal output from the load cell is amplified and converted to a digital readout through integrated circuits mounted on plug-in circuit boards. The circuit boards include standard and optional amplifiers, power supplies, filter, and converter. Front panel controls enable convenient adjustment of instrument zero and span levels. The front panel digital multiplier control permits the basic full scale range to be changed to count by 2, 3, 4, etc, to 9, providing full scale range to ±20,000, ±30,000, ±40,000, etc, to ±90,000. With the addition of option 01, Dummy Zero, the full scale ranges and multiplier positions are increased by a factor of 10. The multiplier feature, with the INPUT mV/V switch (2. 4mV/V or 3. 6mV/V) combines the Model 8200 with virtually any BLH strain gage transducer. The LINEARITY control permits precise matching of the Model 8200 and load cell. This function requires dead weight loading of the transducer and Indicator. BLH provides appropriate curves with 8200 Calibration kits (Indicator and load cell combined in a system). The 8200 has a calibrated ZERO mode and a check CAL mode for checking the zero and span of the Indicator at any time without interrupting the measuring process. Rear panel connectors and terminal strips are provided to interface system power and signal functions with external equipment. Readout is illuminated digital display and optional BCD.

1-7. Characteristics.

1-8. Detailed specifications for the Model 8200 Calibration Indicator are listed in Table 1-1. A complete description of controls and functions is included in Section II of this manual.

1-9. Optional Equipment.

1-10. The following options or accessories are available:

a. Option 01: DUMMY ZERO. Nonactive sixth digit for indicating in engineering units of 100 000 or more.

b. Option 03: ACTIVE FILTER. Eliminates pulsating or cyclic load induced signals.

c. Option 04: BCD OUTPUT. 5 BCD 1-2-4-8 digits plus single bit polarity made available with addition of connector J9 for external devices such as printers, computers, data acquisition systems, etc.

d. Option 09: 230 VOLTS. Indicator is factory wired for operation from 230V, ±10%, 50-400Hz source.

e. Option 10: PANEL MOUNT BEZEL KIT. P/N 404327-1 for mounting 8200 in panel.

f. Option 11: PANEL MOUNT BEZEL 19" KIT. P/N 412303-1 for mounting single 8200 Indicator with 19" panel.

g. Option 12: 19" RACK MOUNTING KIT. P/N 405477-1 for mounting 8200 with blank panel in 19" rack.

h. Option 13: FULL WIDTH CASE WITH BLANK PANEL. P/N 413711-1 for 8200 configured for bench mount with blank panel in full width case.

i. Option 14: FULL WIDTH CASE WITH BLANK PANEL AND BEZEL. P/N 404326-1 for 8200 mounted in full width case with blank panel and bezel.

j. Option 20: EXTENDER BOARD. Printed circuit board P/N 411621-2 for extending plug-in boards for servicing.

k. Model 625 Calibrator. Provides fifty-five extremely accurate millivolt-per-volt signals to check instrumentation associated with transducers. The 625 substitutes for the transducer and the readout is then verified.

l. Cable Extension Box. Junction box used to splice extension cables to existing transducer cable. Explosion-proof type available for use in hazardous location.

Table 1-1. Model 8200 Specifications.

INPUT:	±1mV/V = 10,000 counts, overranges to 17,000 counts. (1μV/count referred to input)
NO. OF TRANSDUCERS:	Up to 8 350Ω bridges or 4 120Ω bridges with up to 1000' of the transducer cable length (6 wires).
BRIDGE EXCITATION:	10.00 Vdc at 350mA, short circuit protected. 5.0 Vdc at 200mA and 15.0 Vdc at 200mA can be supplied on special order (max. cable length is 500' with 15.0V bridge excitation).
DISPLAY:	5 active digits, polarity and optional dummy zero.
SYSTEM ACCURACY:	0.05% of reading to 30% of full scale, assuming 12,000 counts equals full scale.
LINEARIZATION:	Calibrate linearizing dial with minimum compensating range of ±0.3%
RESOLUTION:	± 0.01%
SPAN ADJUSTMENT:	Selected coarse span resistor plus a 10 turn fine span adjustment with a nominal range of ±10% (2.4mV/V), ±7% (3.6mV/V).
OPERATING TEMPERATURE RANGE:	+40°F to 130°F.
TEMPERATURE EFFECT:	On Zero: ±0.001%/°F of full scale or ±0.25μV/°F, whichever is greater.
	On Span: ±0.005%/°F of each span range.
AMPLIFIER INPUT IMPEDANCE:	50MΩ
AMPLIFIER EXIT CURRENT:	0.5μA
COMMON MODE REJECTION:	Essentially infinite at DC (auto-zero preamplifier), 100dB to 5K Hz.
COMMON MODE VOLTAGE LIMIT:	±8V.
REMOTE SENSE IMPEDANCE:	5KΩ (compensating network provides an effective remote sensing impedance of 100KΩ).
ANALOG OUTPUTS:	0 to ±5.0V buffered, 2mA, ±0.25% accuracy.
DIGITAL MULTIPLIER:	Front panel 9-position switch permitting the indicator to read 10 000 counts regardless of the transducer's full scale capacity to obtain maximum readability, i.e., 10 000 counting by 1 20 000 counting by 2 30 000 counting by 3 up to 90 000 counting by 9.
DISPLAY TYPE:	Numerical display neon tubes with 5/8" numerals.
DISPLAY STORAGE:	Display storage (non-blinking operation) for all digits and polarity.
DISPLAY HOLD:	Display maintains the last reading indefinitely when external command is applied.
MEASURING SPEED:	3 readings per sec. Externally variable up to 1 reading every 2 sec.
DIGITAL OUTPUTS (OPTIONAL)	5 BCD 1-2-4-8 digits plus single bit polarity.

Table 1-1. Model 8200 Specifications (cont'd)

LOGIC LEVELS AND CURRENTS: (standard TTL)	Logical "1": +2. 4V min. Logical "0": +0. 4V max. All digital output signals are capable of sinking 8mA at lower logic level and sourcing 0. 2mA at upper logic level.
DATA READY SIGNAL:	Upper level (+2. 4V min) to lower level (+0. 4V max) transition with output returned to upper level exponentially in 12μ sec. (nom).
POWER:	115V ±10% or 230V ±10%, 50 to 400Hz, 25W nominal, 8 ft. cable supplied terminated in 3-wire grounding type plug.
INPUT/OUTPUT CONNECTIONS:	All input /output connections are made at the rear of the instrument.
WEIGHT:	14 pounds.
DIMENSIONS:	5 1/4 x 8 1/2 x 19 5/16 inches (standard mounting).
STORAGE TEMPERATURE:	-5°F to +150°F.
WARMUP PERIOD:	30 minutes to listed specifications.
ELECTRONIC DAMPING CAPABILITY:	Optional active filter.

Cut Off Frequency (f_c)	0. 3Hz
Rise Time: to 99. 9%	6. 2 sec.
Attenuation at f_c	3 db
Attenuation at f = 5Hz	37 db
Attenuation at f = 15Hz	80 db
Max. Rolloff	60 db/decade
Gain	1. 0 ±0. 05% up to 0. 2f_c
Offset Voltage	6mV (adj. zero with trim pot)

GRAVITY EFFECT:	BLH force transducers are calibrated in true force units.

NOTES

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information on unpacking, inspection, installation and repacking for shipment, if necessary.

2-3. INITIAL INSPECTION.

2-4. Mechanical Inspection.

2-5. If external damage to the shipping carton is evident, ask the carrier's agent to be present when the instrument is unpacked. Check the unit for external damage such as broken controls or connectors, and dents or scratches on the panel surface. If damage is found, refer to Paragraph 2-8 for recommended claim procedure and repacking information. If shipping carton is not damaged, check the cushioning material and note any signs of severe stress as an indication of rough handling in transit. Retain the packing material for possible future use.

2-6. Electrical Check.

2-7. Check the electrical performance of the equipment as soon as possible after receipt. The preoperational calibration check and the normal operation process should provide a valid indication of satisfactory performance.

2-8. CLAIMS AND REPACKING.

2-9. Claims for Damage.

2-10. If physical damage is evident or if the instrument does not meet specifications when received, notify the carrier and the nearest BLH Sales/Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.

2-11. Repacking for Shipment or Storage.

2-12. If the instrument is to be shipped to a BLH Sales/Service Office, or to the factory, attach a tag showing owner with address, instrument model and serial number, and the repair required. The original shipping carton and packaging material may be reusable. The BLH Sales/Service Office will also provide information and recommendations on materials to be used if the original packaging material is not available or not reusable. Materials should include, (1) a double-walled carton (check with a freight carrier for test strength required), (2) polyfoam, heavy paper, or sheets of cardboard, to protect all instrument surfaces; use extra material around projecting parts of the instrument, (3) at least four inches of tightly-packed, shock absorbing material surrounding the instrument. Close the package securely with heavy paper tape.

2-13. INSTALLATION.

2-14. General.

2-15. Installation of each BLH Model 8200 Indicator differs slightly depending upon the mounting configuration specified and the number of transducers in use. Power requirements, mounting information, fusing, and transducer/indicator interface information are discussed in the following paragraphs.

2-16. Location.

2-17. The instrument will operate satisfactorily between +32°F and 130°F in most environments. In system applications, however, the narrowest temperature range of a given system component should be used as the determining factor. System location should be relatively free from dust, unusual temperature extremes, high humidity and vibration. The System should not be located in areas containing explosive or corrosive vapors or in the vicinity of strong magnetic fields (e. g. large power transmission cables, welding equipment, high voltage transformers, etc).

2-18. Mounting.

2-19. The instrument can be bench (portable), rack, or panel mounted, depending upon the type ordered. Conversion kits are available through the BLH Sales/Service Offices listed at the rear of this manual if it becomes necessary to change the original mounting configuration.

2-20. RACK MOUNTING. If ordered as a rack mounted instrument, the Indicator is installed in a mounting enclosure at the factory. The enclosure is shipped with universal mounting flanges attached, ready for installation in a standard 19-inch cabinet; mounting screws are packaged with the instrument.

CAUTION

Ambient temperature in rack during operation should not exceed the maximum specified. Make certain that position in rack permits ample air circulation around the instrument and that nearby instruments do not discharge hot air directly into the 8200.

2-21. PANEL MOUNTING. The panel mounted instrument is shipped from the factory with aluminum bezel packed separately for installation in system control panels. The instrument can be installed in a panel 1/8 to 1 inch thick.

2-22. ELECTRICAL CONNECTIONS.

2-23. General.

2-24. The two major components of an 8200 System -Transducers and Indicator - are interfaced with multiple conductor-shielded cable. Single transducers are connected directly to the rear of the instrument at Terminal Board TB1 with existing four-conductor transducer cable. If necessary, additional cable can be used to extend the length of the run. Extension cables are spliced at a cable extension box designed for this type of application. Four-conductor cabling from multiple transducer installations is joined at a totalizing junction box and brought to the rear of the 8200 with a six-conductor shielded cable. The two extra conductors are remote sensing leads. Remote sensing is discussed in detail in Paragraph 2-31.

2-25. The cable extension boxes where used, should be installed within reach of the four-conductor transducer cables. Cable extension boxes should be mounted where protected from excessive moisture. The boxes should be potted only after a complete check has been run on the system. All connections are made by securing transducer, instrumentation, and power cable leads to barrier-type terminal strips (connectors are optional). Existing cable leads not equipped with lugs can be soldered into place for additional security. Mounting dimensions for cable extension boxes are specified in Figure 2-1.

2-26. Connector J1.

2-27. Rear panel connector J1 performs a multiple function. Pins 36, 21, 22, 23, and 20 are decimal point blanking pins. When these pins are connected to ground, the decimal point to the left of the 2nd, 3rd, 4th, 5th, and 6th digits respectively in the digital display will be blanked. Pins 13 through 18 duplicate the functions of TB1. Voltages for external control functions are available at pins 3 and 5 (±15Vdc regulated) and at pins 30 and 31 (±28Vdc unregulated). Pins 4, 34, and 35 are common. A signal cutoff switch can be installed across pins 1 and 27. This switch will break analog signal at the output of the analog-to-digital converter allowing the analog signal to be utilized elsewhere or to use the DVM section of the 8200 for monitoring external voltages with range of 0-5V = 0-5000 counts. Analog output is also developed on pin 26 during normal instrument operation without switching. The standard sampling rate (three readings per second) can be slowed to a maximum of one reading every two seconds by placing a one-megohm resistor or potentiometer across terminals 19 and 37. Remove internal jumper between E1 and E2 when external sample rate control is used. Figure 2-2 identifies all functional pins on J1.

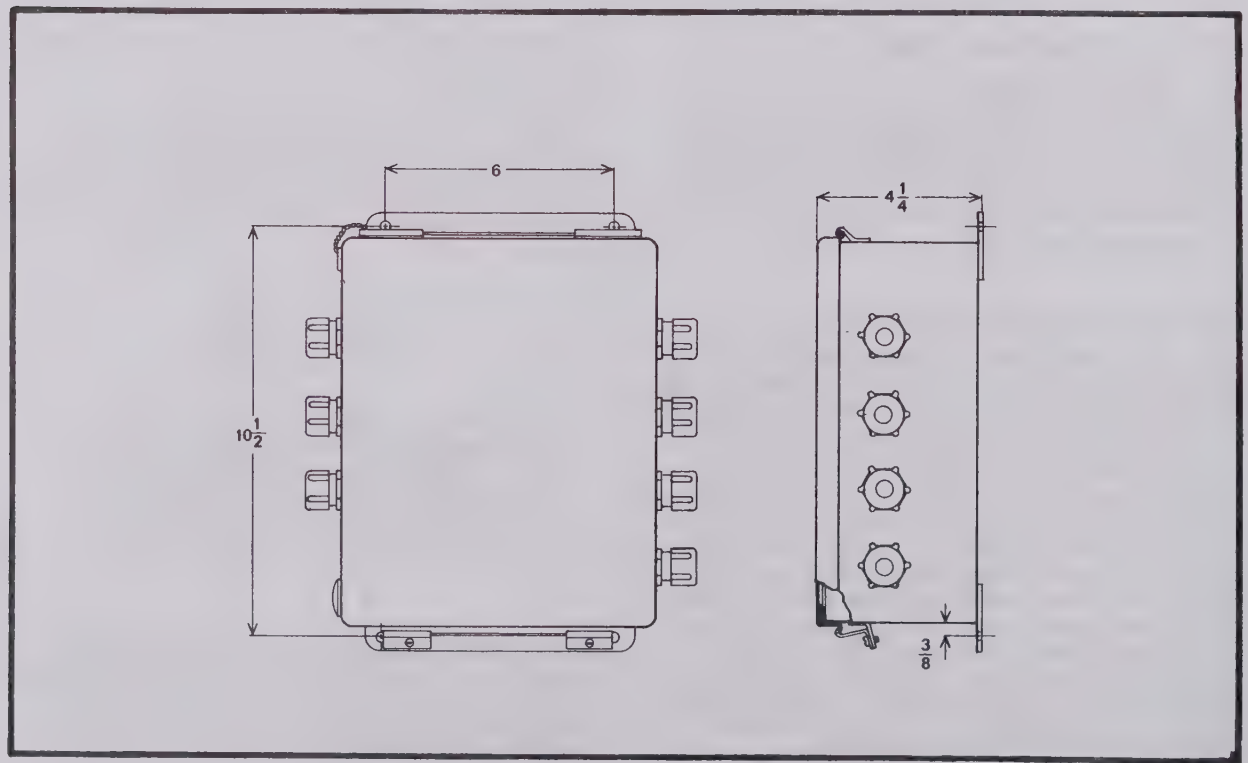


Figure 2-1. Junction Box Mounting Dimensions.

CONNECTION DATA

J1

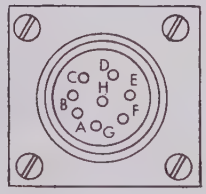
PIN	FUNCTION
1	REMOTE SIGNAL CONTROL INPUT, ANALOG OUTPUT
2	REMOTE SPAN CONTROL
3	+15V
4	COMMON (AC SIGNAL)
5	-15V
6	REMOTE SPAN CONTROL
7	MULTIPLIER PROGRAMMING PIN*
8	MULTIPLIER PROGRAMMING PIN*
9	MULTIPLIER PROGRAMMING PIN*
10	MULTIPLIER PROGRAMMING PIN*, +15V
11	MULTIPLIER PROGRAMMING PIN*
12	MULTIPLIER PROGRAMMING PIN*
13	+ EXCITATION
14	- EXCITATION
15	- SIGNAL IN
16	+ SIGNAL IN
17	- REMOTE SENSING
18	+ REMOTE SENSING
19	SAMPLE RATE CONTROL POTENTIOMETER
20	DECIMAL POINT BLANKING PIN (SIXTH DIGIT)
21	DECIMAL POINT BLANKING PIN (THIRD DIGIT)
22	DECIMAL POINT BLANKING PIN (FOURTH DIGIT)
23	DECIMAL POINT BLANKING PIN (FIFTH DIGIT)
24	FULL SCALE COUNT OUT
25	TRANSDUCER NONLINEARITY ADJUSTMENT (+)
26	UNFILTERED OUTPUT
27	REMOTE SIGNAL CONTROL - FILTER OUTPUT
28	REMOTE LINEARITY ADJUSTMENT (-)
29	NOT USED
30	-28V (UNREGULATED)
31	+28V (UNREGULATED)
32	NOT USED
33	REMOTE FILTER INPUT
34	COMMON (DC SIGNAL)
35	COMMON (DC SIGNAL)
36	DECIMAL POINT BLANKING PIN (SECOND DIGIT)
37	SAMPLE RATE CONTROL

*Optional: may not be used.

J9

PIN	FUNCTION	PIN	FUNCTION
5	BCD OUT (FIRST DIGIT) 1	35	NOT USED
6	BCD OUT (FIRST DIGIT) 2	36	NOT USED
7	BCD OUT (FIRST DIGIT) 4	37	NOT USED
8	BCD OUT (FIRST DIGIT) 8	26	BCD OUT (FIFTH DIGIT) 1
9	BCD OUT (SECOND DIGIT) 1	27	BCD OUT (FIFTH DIGIT) 2
12	BCD OUT (SECOND DIGIT) 2	28	BCD OUT (FIFTH DIGIT) 4
13	BCD OUT (SECOND DIGIT) 4	29	BCD OUT (FIFTH DIGIT) 8
14	BCD OUT (SECOND DIGIT) 8	3	BCD POLARITY BIT (+)
15	BCD OUT (THIRD DIGIT) 1	4	BCD POLARITY BIT (-)
16	BCD OUT (THIRD DIGIT) 2	1	HOLD
17	BCD OUT (THIRD DIGIT) 4	2	HOLD
18	BCD OUT (THIRD DIGIT) 8	22	DATA READY
19	BCD OUT (FOURTH DIGIT) 1	31	COMMON
20	BCD OUT (FOURTH DIGIT) 2	10	DECIMAL POINT BLANKING PIN (SECOND DIGIT)
24	BCD OUT (FOURTH DIGIT) 4	11	DECIMAL POINT BLANKING PIN (THIRD DIGIT)
25	BCD OUT (FOURTH DIGIT) 8	21	DECIMAL POINT BLANKING PIN (FOURTH DIGIT)
32	NOT USED	23	DECIMAL POINT BLANKING PIN (FIFTH DIGIT)
33	NOT USED	30	DECIMAL POINT BLANKING PIN (SIXTH DIGIT)
34	NOT USED		

J10



PIN	FUNCTION
A	EXCITATION (+)
B	REMOTE SENSING (+)
C	SIGNAL IN (-)
D	SIGNAL IN (-)
E	EXCITATION (-)
F	REMOTE SENSING (-)
G	SIGNAL IN (+)
H	SIGNAL IN (+)

TB1

PIN	FUNCTION	PIN	FUNCTION
1	+ 10 Vdc EXCITATION (GREEN)	5	+ SIGNAL IN (WHITE)
2	+ REMOTE SENSING (ORANGE)	6	- SIGNAL IN (RED)
3	- REMOTE SENSING (BLUE)	7	GROUND (YELLOW)
4	- 10Vdc EXCITATION (BLACK)		

Figure 2-2. Rear Panel Connection Data

2-28. Connector J9.

2-29. Connector J9 is a 37-pin connector mounted on rear panel above J1. Twenty-eight pins are utilized for the actual BCD output and decimal selection functions. HOLD (pin 1) and HOLD (pin 2) are normally jumpered; breaking the connection (as with a momentary pushbutton switch) stops sampling and allows printer or other external device to accurately record last indicated reading. Pin 22 (data ready signal) indicates that measurement cycle is completed and that data is ready to read (by external device, i. e. printer). Upper level (+24V minimum) to lower level (+0. 4V maximum) transition with output returned to upper level exponentially in 12 μsec (nom). Figure 2-7 identifies pin function and location. J9 mates with Cannon#2DA31P (BLH# 137410-8) not supplied unless specified.

2-30. TRANSDUCER CONNECTIONS. Connect the transducer to Terminal Board TB1 directly or through the extension box as shown in Figures 2-3 and 2-4. Figure 2-2 identifies function of each terminal on TB1. Connector J10 parallels TB1 for transducers with cable connector.

2-31. REMOTE SENSING. Remote sensing is a bridge excitation technique widely used in transducer applications. Basically, when transducers are installed at a considerable distance from the instrument, ambient temperature variations tend to raise or lower the resistance of the cable which, in turn, reduces or increases the applied bridge voltage in proportion to the change. To compensate for this effect, two additional lead wires, called sensing leads (color-coded BLUE and ORANGE), are connected to the power input leads of the transducer at, or as close to the transducer as possible, typically at the cable extension box. For polarity purposes the ORANGE sensing lead should be connected to the GREEN positive power input lead and the BLUE sensing lead connected to the BLACK negative power input lead.

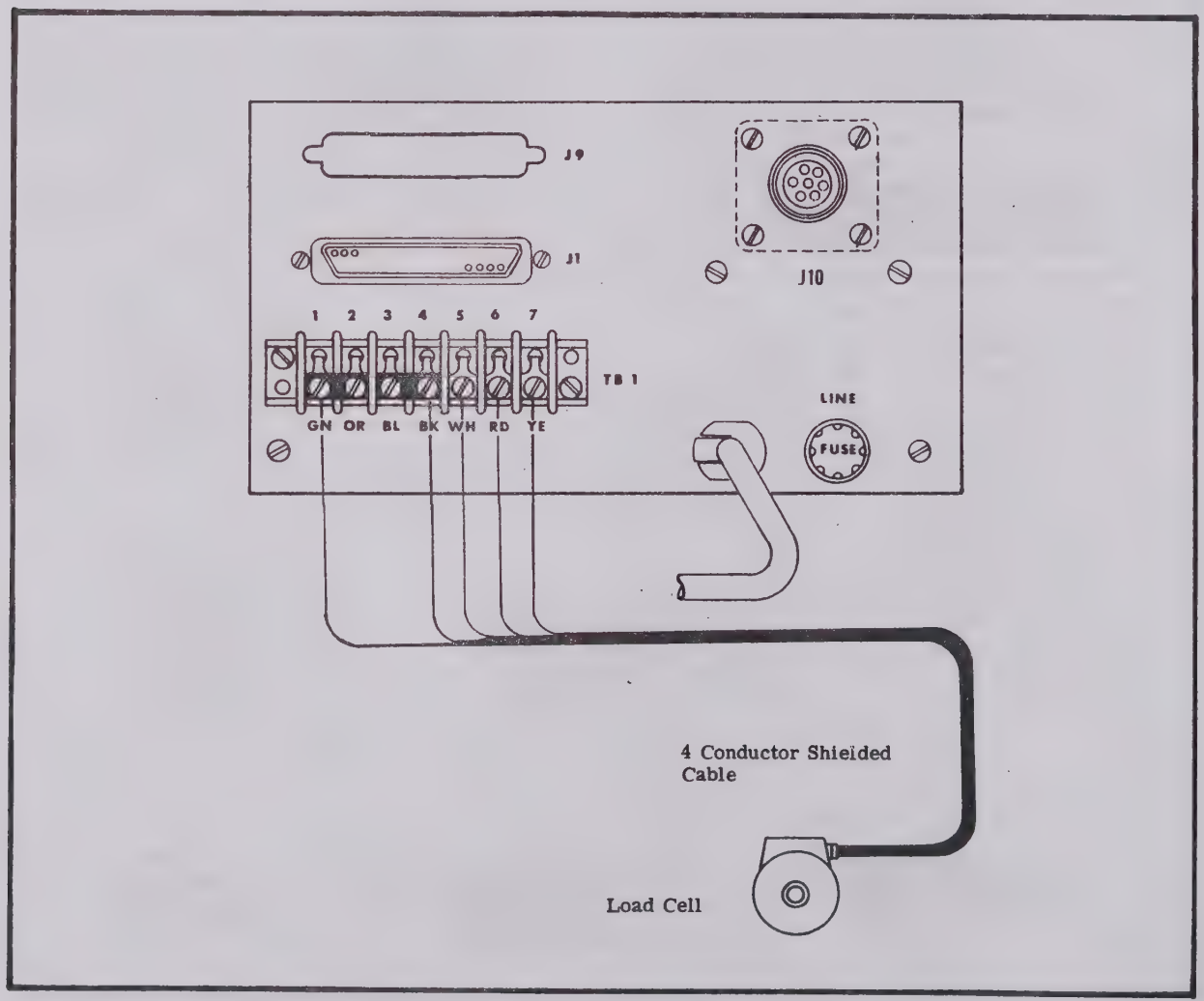


Figure 2-3. Single Transducer Connected Directly To Rear of 8200.

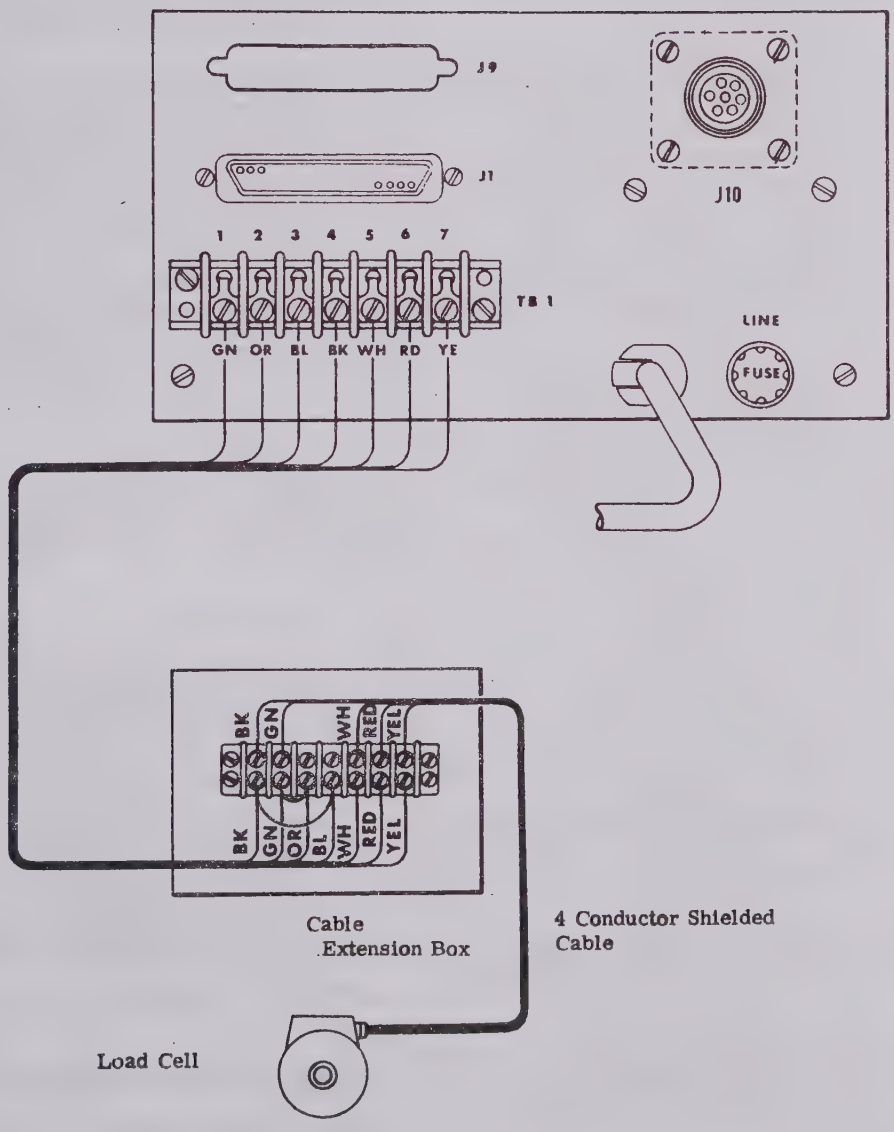


Figure 2-4. Connections With Single Transducer, Remote Sensing.

2-32. If the remote sensing technique is used, remove the jumper links on Terminal Board TB1. Connect the Indicator to the cable extension box with six-conductor cable as shown in Figure 2-4. The transducer is connected to the box with existing four-conductor cable. Transducer cabling can be lengthened as necessary through additional cable extension boxes. Note that remote sensing connections (BLACK to BLUE and GREEN to ORANGE) are made in the boxes, the closest point to the transducer, rather than at Terminal Board TB1.

2-33. When the transducer is connected to Terminal Board TB1 as indicated in Figures 2-4, any temperature induced change in load at the transducer produces a signal which is applied to the error reference circuit of the power supply. The temperature caused signal is amplified and referenced to a known voltage source before being applied to the base of the series regulator. This bias causes a precisely regulated increase or decrease in excitation voltage to be applied to the transducer, effectively compensating for any temperature induced change in cable wire resistance.

2-34. CABLE EXTENSION BOX CONNECTIONS. A Cable Extension Box is used when the existing transducer cable is not long enough to reach the indicator in single cell systems or the totalizer box in multiple cell systems. The cable extension box contains a single terminal strip marked BLK, GRN, OR, RED, BLU, WHT, and YEL. The four-conductor cable from the transducer is connected color-for-color to the BLK, GRN, RED, and WHT terminals. Connect the YELLOW cable shield to the YEL terminal. If remote sensing is not necessary, connect a four-conductor cable to the other side of the terminal strip and make connections to the rear of the signal conditioner as shown in Figure 2-3.

2-35. EXPLOSION-PROOF (EX-TYPE) BOXES. When explosion-proof extension boxes are specified, equipment approved for use in National Electrical Code, Class I, Division 1, locations is supplied. The boxes have been tested and are suitable for use in Class D atmospheres. Explosion-proof equipment is defined by the NEC as "... a case which is capable of withstanding an explosion of a specified or vapor which may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and it must operate at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby." Installation of explosion proof equipment must be in accordance with Article 501 of the NEC. Refer to the National Electrical Code, Articles 500 through 503, for additional information on installation and wiring of explosion-proof equipment.

2-36. FINAL WIRING CHECK. After all wiring is completed, check terminations for proper soldering and tight terminal connections. Check and tighten each connector to assure full engagement and proper seating. Provide strain reliefs where necessary. Do not pot the cable extension box until this check has been made.

2-37. Power Requirements.

2-38. The standard Indicator can be operated from any 115Vac 50 to 400Hz power source; power dissipation is 25W. (Indicators wired for operation at 230Vac are available on special order). Check that instrument is capable of operation at desired voltage before applying power. Overcurrent protection is provided by a rear panel mounted 0. 3 ampere time-delay fuse.

2-39. AC POWER CABLE. To protect operating personnel, the National Electrical Manufacturer's Association recommends that the instrument panel and cabinet be grounded. The instrument is equipped with a six-foot three-conductor power cable. The third conductor is the ground conductor, and when the instrument is plugged into an appropriate receptacle the Indicator is grounded. The offset pin on the power cable three-prong plug is the ground connection. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green lead on the adapter to ground.

2-40. CONTROLS.

2-41. Controls used to operate and calibrate the instrument are listed and identified in Figure 2-5. Figure 2-6 identifies and describes rear panel connections.

2-42. CALIBRATION.

2-43. The Indicator measuring circuits contain both fixed and variable high-stability, precision wirewound resistors for long dependable service. Once adjusted, the Indicator seldom requires recalibration. If, however, the accuracy of the Indicator is in doubt, the calibration should be checked and if necessary the instrument and load cell should be returned to BLH for recalibration with test instruments traceable to the National Bureau of Standards. BLH recommends annual or semi-annual recalibration. If calibration is checked in the field the standard being used must be better than two times the instrument accuracy, preferably five times.

2-44. INITIAL CALIBRATION PROCEDURE.

2-45. Preliminary.

a. Complete rear panel connections and all external wiring.

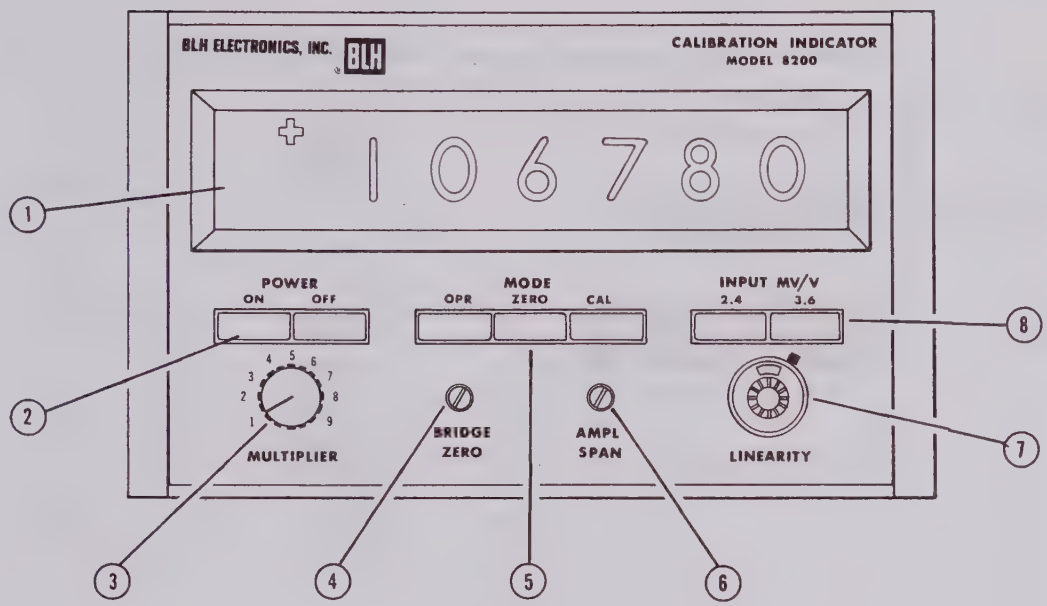
b. Press POWER ON switch. Allow 30 minutes warmup period.

c. Set MODE switch to the OPR position.

d. Set MULTIPLIER switch for desired full scale count, 1 for 10,000, 2 for 20,000, etc.

e. Set INPUT MV/V switch to the appropriate setting for transducer in use.

FRONT PANEL



(1) DIGITAL DISPLAY. 5/8-inch neon numerals. Five active digits with optional polarity and dummy zero tubes.

(2) POWER ON/OFF. Applies line power (105-125Vac 50-400Hz at approximately 25 watts) to the instrument.

(3) MULTIPLIER. Nine-position switch for digital scaling of the readout to match the full scale output of the system. (See specifications).

(4) BRIDGE ZERO. Screwdriver adjustable control. Cancels initial unbalance of the transducer bridge before actual load is applied.

(5) MODE, OPR-ZERO-CAL. 3-section switch for selective different modes of operation. OPR connects external device into circuit. ZERO and CAL opens input and inserts precise zero or calibration signal.

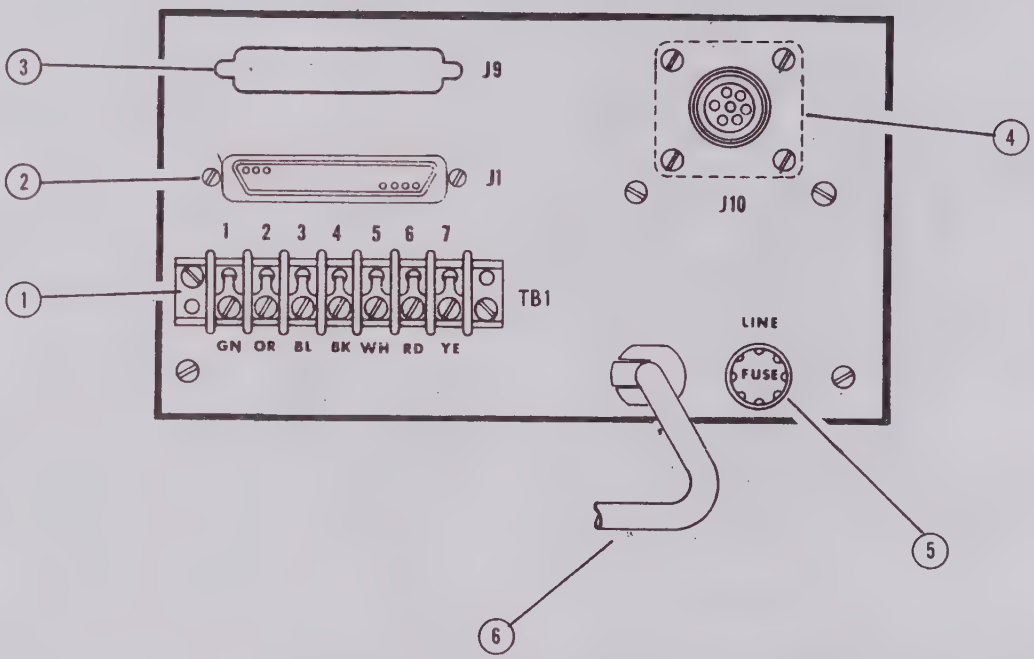
(6) AMPL SPAN. Screwdriver adjustable control.

(7) LINEARITY. 10-turn precision potentiometer used to adjust the reading so that the instrument matches the performance curve of a particular transducer.

(8) INPUT MV/V. 2-section switch for selecting one of two full scale input levels corresponding to transducer in use. 2. 4mV/V for 2mV/V transducers; 3. 6mV/V for 3mV/V transducers.

Figure 2-5. Front Panel Control Data.

REAR PANEL



(1) TB-1. Transducer excitation and signal input terminal board. See Figure 2-2 for terminal function.

(2) Connector J1. Thirty-seven pin connector. Provides connection points for decimal point blanking, external sample rate control and multiplier programming. See Figure 2-2 for pin function.

(3) Connector J9. Thirty-seven pin connector for BCD output function, printer control and decimal point blanking. See Figure 2-2 for details.

(4) J-10. Optional connector location for transducer cable connection. Parallel with TB-1.

(5) Line Fuse. 0. 3 ampere 230V time-delay fuse (Slo-Blo).

(6) Power Cord. Three-conductor power cord for primary line voltage input.

Figure 2-6. Rear Panel Control Data.

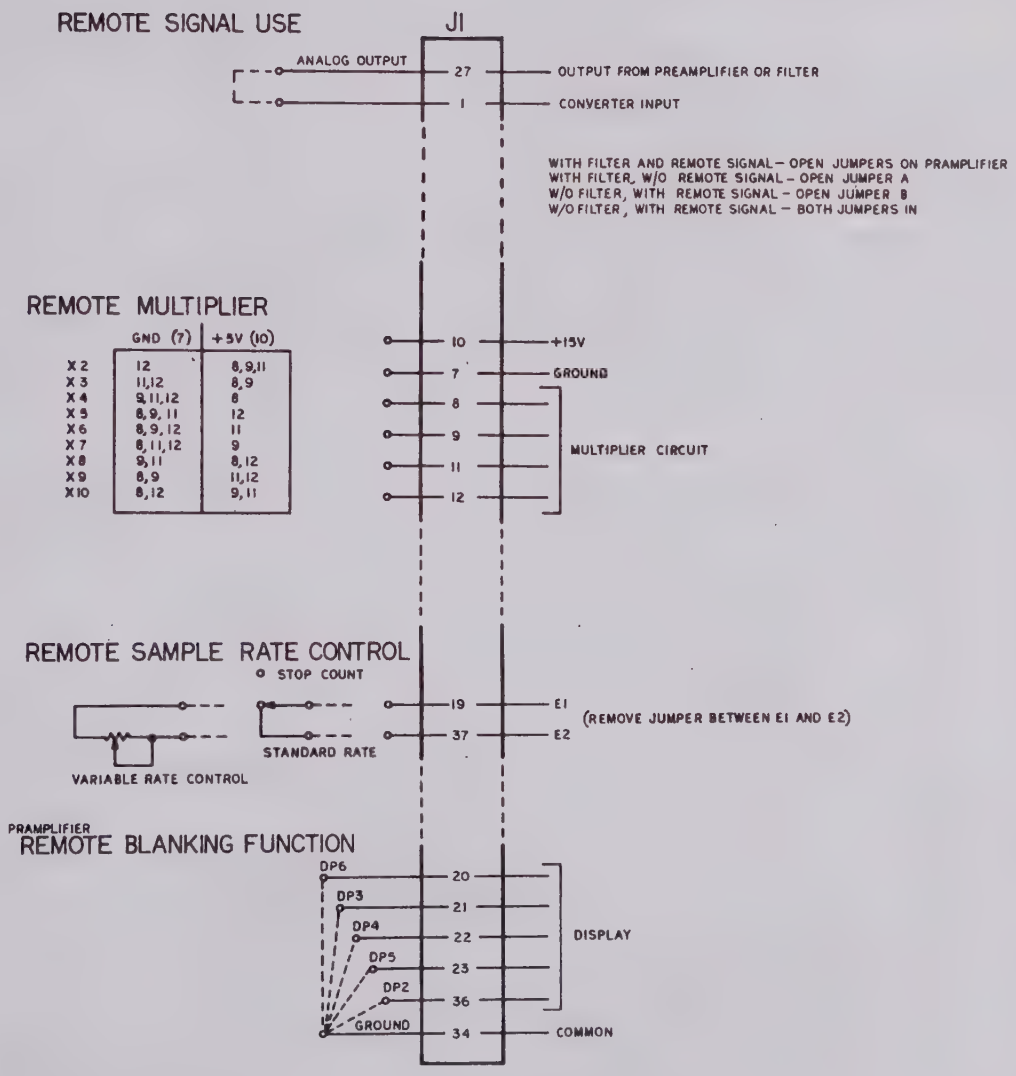


Figure 2-7. Remote Control Connection Data

NOTES

SECTION III
OPERATION

3-1. GENERAL.

3-2. Illustrations of the control panel in this Section are used to describe the sequential operation of the system. The circled numerals on the controls are keyed to the step, or steps, in which the control is used. The operating procedure assumes that all connections and initial adjustments have been made as part of the installation (preceding section).

3-3. PREVENTIVE MAINTENANCE.

3-4. Cleaning.

3-5. BLH Model 8200 Indicators are enclosed in a vinyl coated aluminum cabinet and should be cleaned only with a damp cloth moistened in a solution of warm water and a mild detergent. Do not use any chemical solvents or abrasive cleaners on the vinyl case or anodized aluminum surfaces. Use a soft camel hair brush to remove external dust accumulation. Loose dust within the chassis can be removed with dry, low-pressure, compressed air or a small vacuum cleaner during the periodic maintenance check. Clean all mating connectors before reassembling the instrument.

3-6. Periodic Check.

3-7. BLH recommends that the instrument be performance tested by performing the calibration process before operation and at periodic intervals thereafter. The instrument can be returned to BLH for a thorough overhaul whenever necessary and checked with test instruments traceable to the National Bureau of Standards. If user maintenance and calibration is not feasible, or if unusual problems or applications are encountered, a visit by a BLH Field Service Engineer can be arranged through any of the BLH Sales / Service Offices listed at the rear of this manual.

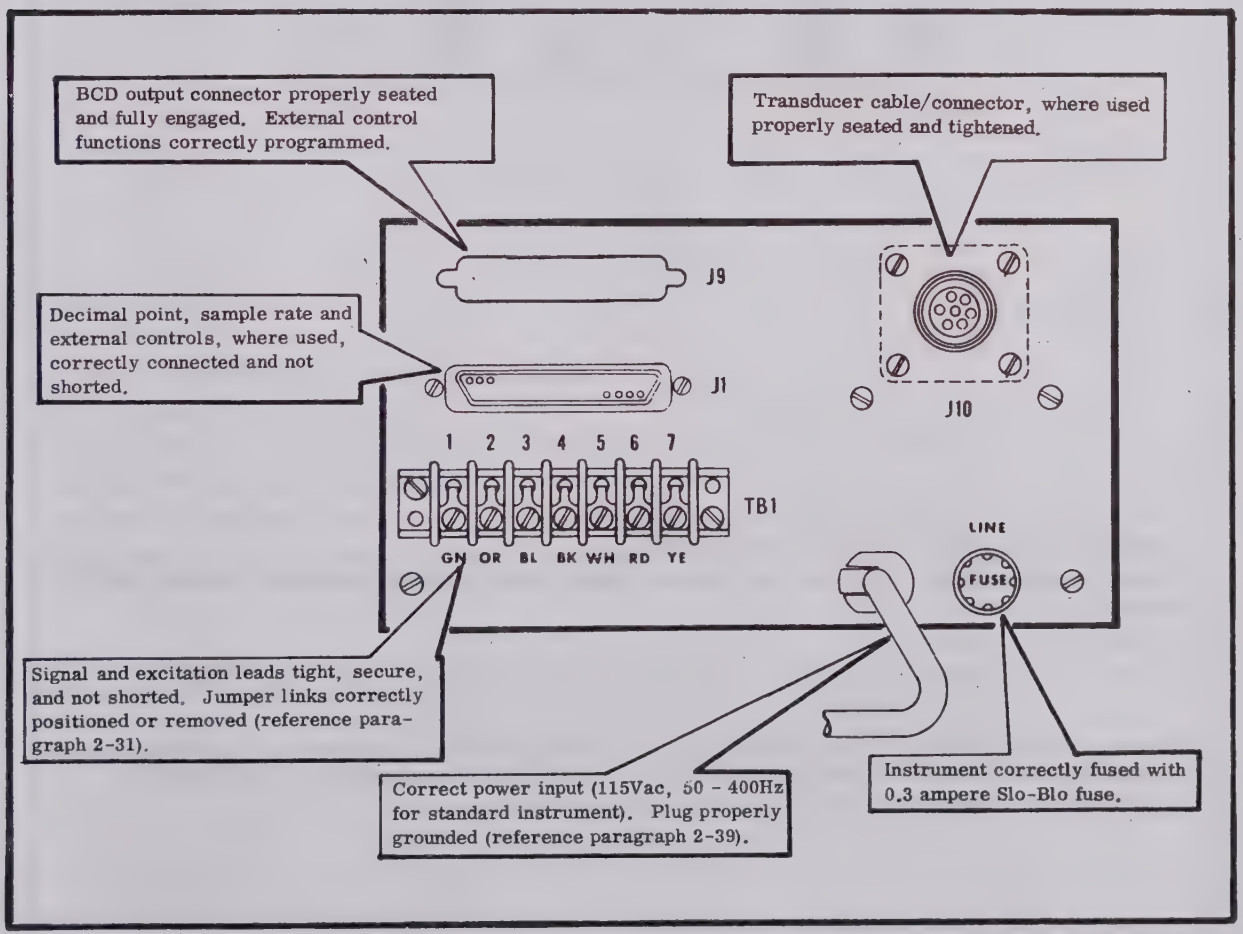
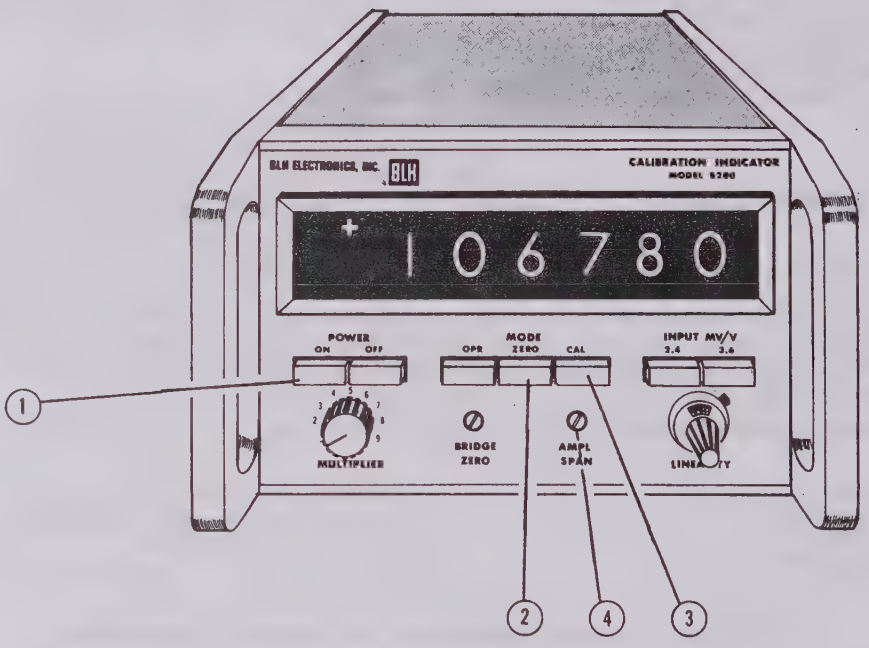

BCD output connector properly seated and fully engaged. External control functions correctly programmed.
Transducer cable/connector, where used properly seated and tightened.
J9
J10
Decimal point, sample rate and external controls, where used, correctly connected and not shorted.
J1
1 2 3 4 5 6 7
TB1
GN OR BL BK WH RD YE
LINE
FUSE
Signal and excitation leads tight, secure, and not shorted. Jumper links correctly positioned or removed (reference paragraph 2-31).
Correct power input (115Vac, 50 - 400Hz for standard instrument). Plug properly grounded (reference paragraph 2-39).
Instrument correctly fused with 0.3 ampere Slo-Blo fuse.

Figure 3-1. Preoperational Connector Check

CALIBRATION CHECK

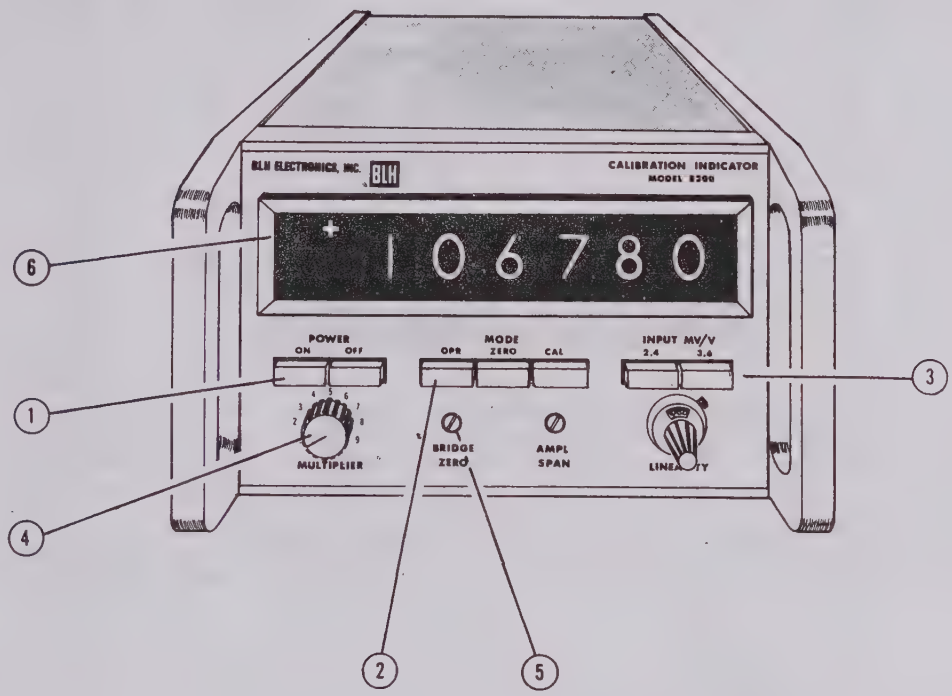


1. Press POWER ON switch; allow 30 minutes warmup.
2. Set mode switch to ZERO. Readout should indicate 00000. If not, remove cover and adjust R29 on preamplifier.
3. Set mode switch to CAL.
4. If necessary, adjust AMPL SPAN control so that readout agrees with check CAL figure (Table 3-1).

NOTE: This calibration check can be performed any time during a loading cycle whether or not the transducer is under load. The process provides a check of the instrument calibration only since the transducer is not in the circuit in the ZERO and CAL Modes.

Figure 3-2. Calibration Check

OPERATION

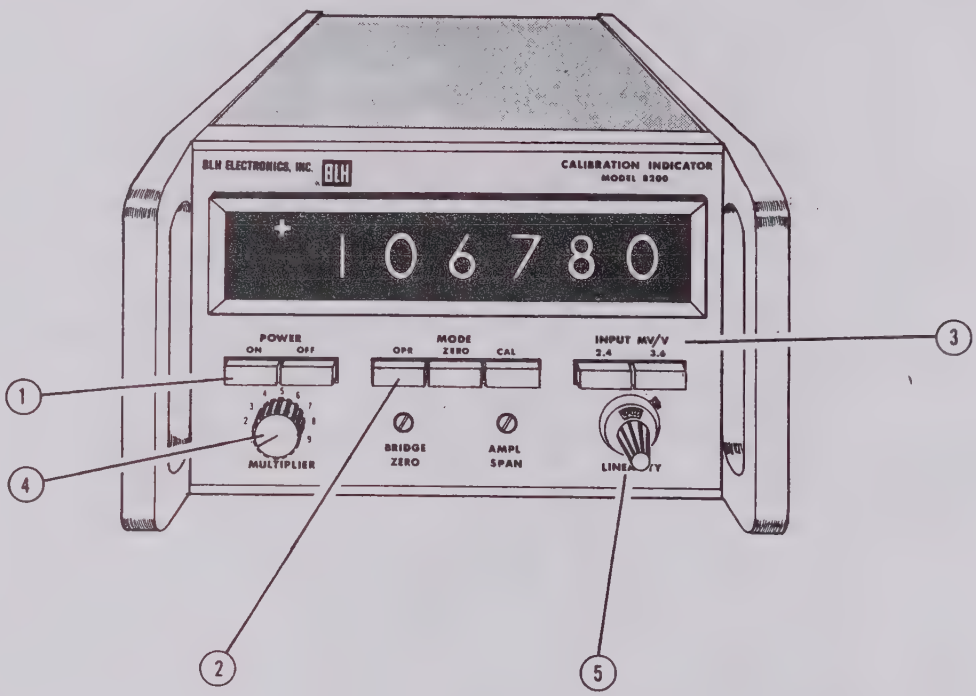


1. Press POWER ON; allow 30 minutes for warmup.
2. Press Mode OPR switch.
3. Set MV/V switch to agree with transducer full scale output for cell in use (see Table 3-1).
4. Set MULTIPLIER switch as desired; 1 for 10,000 counts, 2 for 20,000, etc.
5. With no load applied to transducers, adjust BRIDGE ZERO control until digital display indicates 00000.
6. Apply load to transducer; output will appear on digital display; negative readings indicate tension loading, positive readings indicate compression loading.

IMPORTANT: Set LINEARITY control to 500 when linearizing function is not to be used to eliminate correction voltages being generated by the linearity circuit.

Figure 3-3. Operation

LINEARIZING



1. Press POWER ON; allow 30 minutes warmup.
2. Press mode OPR switch.
3. Set MV/V switch to agree with transducer in use (Table 3-1).
4. Set MULTIPLIER switch as desired.
5. Set LINEARITY control as specified for cell in use and direction of loading (Table 3-1).

NOTE: When linearizing a load cell other than one supplied as part of the Calibration Kit, listed in Table 3-1, the control is set at the approximate center of travel. Follow instruction under Maintenance, Section V, for setting the linearity control.

Figure 3-4. Linearizing

Table 3-1. Calibration Data.

Model 8200 Calibration Indicator Serial No._____

Load Cell

CAP	TYPE	SER. NO.	MV/V	MULT	Compression LIN	Compression CAL	Tension LIN	Tension CAL

NOTES: Data to be included in this table is located on the decal attached to the instrument. Additional correction factors (load and temperature) are to be found on the Calibration Chart Form 701 shipped with the system.

NOTES

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. General.

4-3. The 8200 measurement technique is a sampling function coupled with dual slope integration. Dual slope integration is a two step process. In the first step, the unknown input from the preamplifier is fed through an operational amplifier to an integrating capacitor. The output of this integrator is an increasing voltage with a slope proportional to the input. Integration time is controlled by counting 10,000 counts from a clock oscillator. In the second step, the integrator output is driven back to zero. The slope of the decreasing voltage is constant; therefore the time is proportional to the unknown input. This time is measured by counting pulses from a clock oscillator; the count is converted to BCD, stored, and finally displayed as a decimal digital readout.

4-4. The same integrating components and clock oscillator are used in both steps. Any shift in component values caused by temperature drift or aging is self-cancelling. The second step is a direct comparison to the internal reference voltage ensuring long term stability. The basic concept of dual slope integration is discussed in greater detail in the paragraph dealing with the analog to digital converter circuit.

4-5. DIAGRAMS. The Block Diagram, Figure 4-1, illustrates general electrical arrangement of signal and power supply circuits and direction of signal path. Refer to the Functional Diagram, Figure 4-2, before and during the circuit analysis. In addition to the diagrams described above, each circuit is illustrated in detail for comparison with the functional diagram.

4-6. DESCRIPTION. In the following paragraphs, input circuitry is discussed on the functional diagram level. Operation of the signal circuit is largely dependent upon the timed opening and closing of FET (Field Effect Transistor) switches along the signal path. In the functional diagram these switches are sequentially designated S1, S2, S3, etc. to describe overall circuit functioning. Each of these components has a corresponding circuit diagram designation e. g. S1 is the functional diagram symbol for the FET switch designated Q9 in the detailed circuit diagram of the preamplifier, Figure 4-3. The corresponding switch designations are so indicated when first discussed.

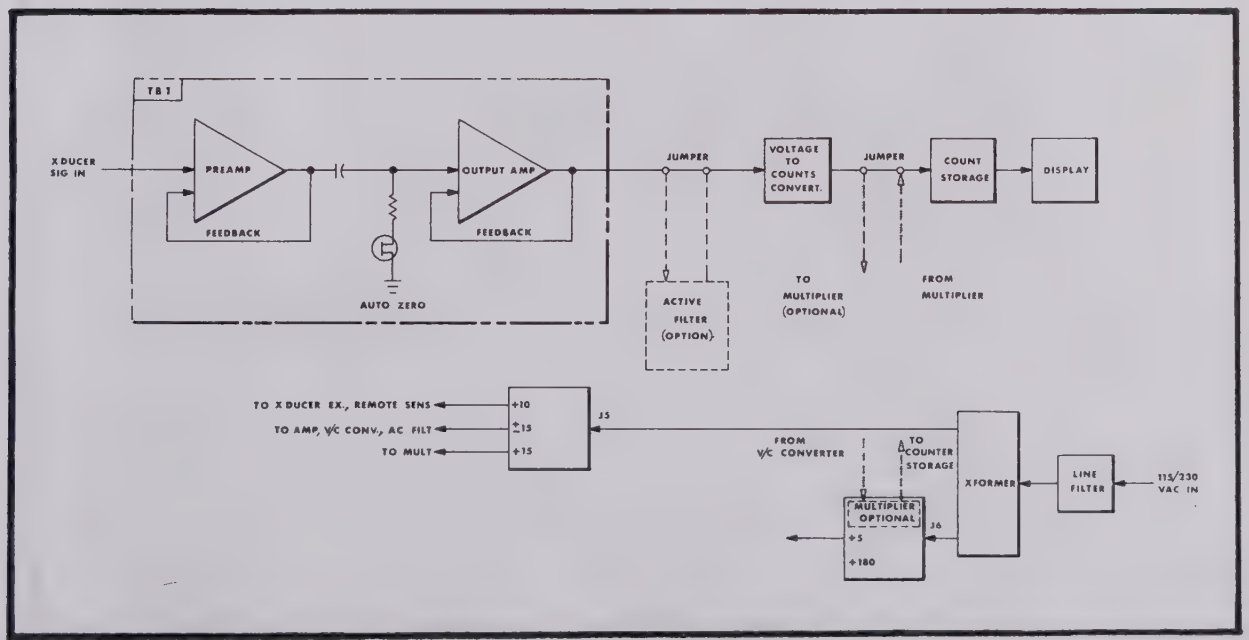


Figure 4-1. Block Diagram

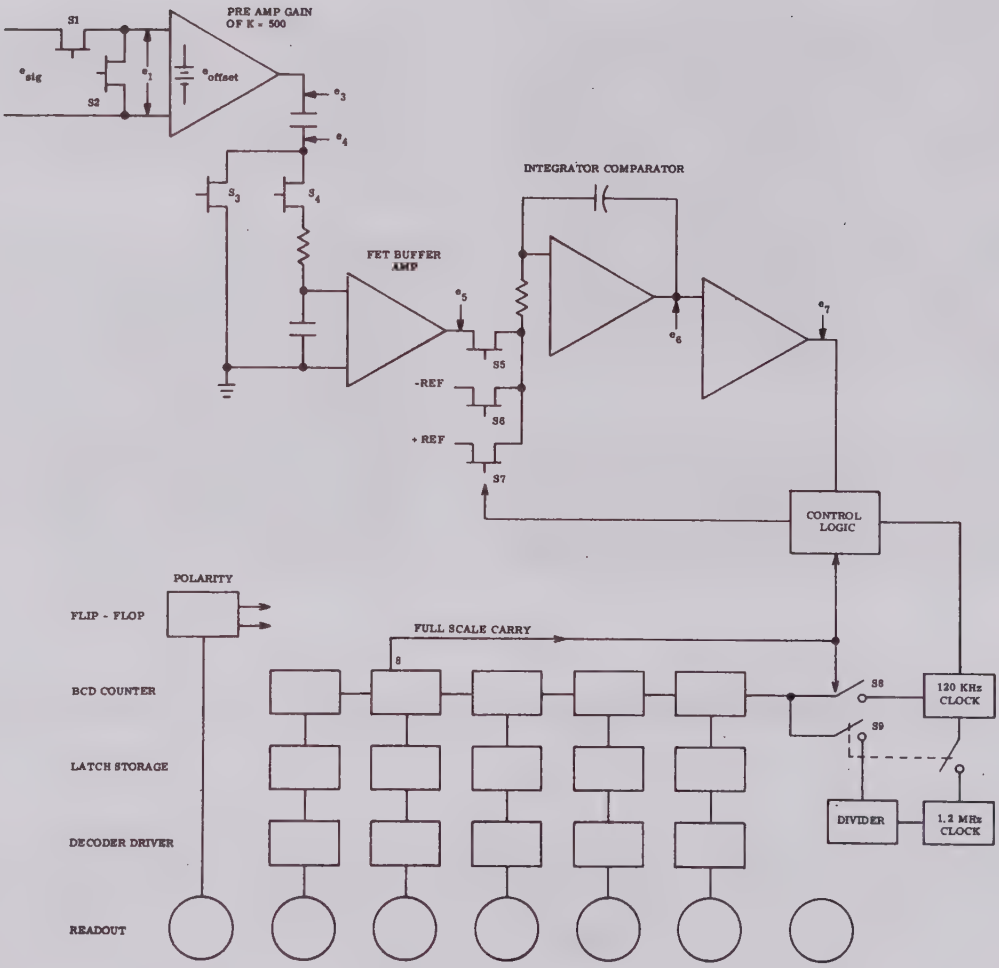


Figure 4-2. Functional Diagram

4-7. SIGNAL CIRCUIT ANALYSIS.

4-8. Input Circuitry.

4-9. The 8200 is designed to operate with 350-ohm or 120-ohm full bridge transducers. Bridge excitation voltage generated by the instrument is 10. 00Vdc at 350mA maximum. In BLH transducers, strain gages are bonded to load sensing elements. Strain gages consist of a grid of fine wire or an etched foil pattern sealed between sheets of paper or plastic film. Constant excitation voltage (10Vdc) is applied across opposite corners of the bridge so that a change in force on the transducers, stretching or compressing the gages and changing the resistance, will produce a change in output voltage. This output voltage is the signal input of the Indicator.

4-10. Preamplifier Circuit.

4-11. The preamplifier, schematic Figure 4-3, conditions the input signal from the transducer for presentation to the A to D converter. An integral part of the preamplifier is the auto-zero circuit which senses and eliminates drift induced offset voltages in the preamplifier.

4-12. Input signals from the signal source (transducer) are applied to the bases of Q1A/B through filter chokes L1 and L2 at pins 22 and 20, respectively. The junction field-effect transistors (JFET) Q8, Q9 are opened and closed by the sampling rate multivibrator Q5, Q6. The outputs from Q1A/B are direct-coupled to the second stage Q3, Q4, which are operated as emitter-followers with the outputs fed to the operational amplifier, integrated circuit IC1. Q2 is a constant-current source for Q1A/B referenced to Zener CR4. The output from IC1 is coupled through C7 and Q10 to the buffer amplifier Q11. Buffer amplifier Q11 is a differential amplifier with the input signal at one gate and a feedback signal at the other gate. The outputs from Q11 drive the integrated circuit IC2. The combination Q11 and IC2 is equivalent to an emitter-follower but with much higher impedance to minimize signal losses. A portion of the output signal is fed to the AMPL SPAN control in the feedback circuit to Q11.

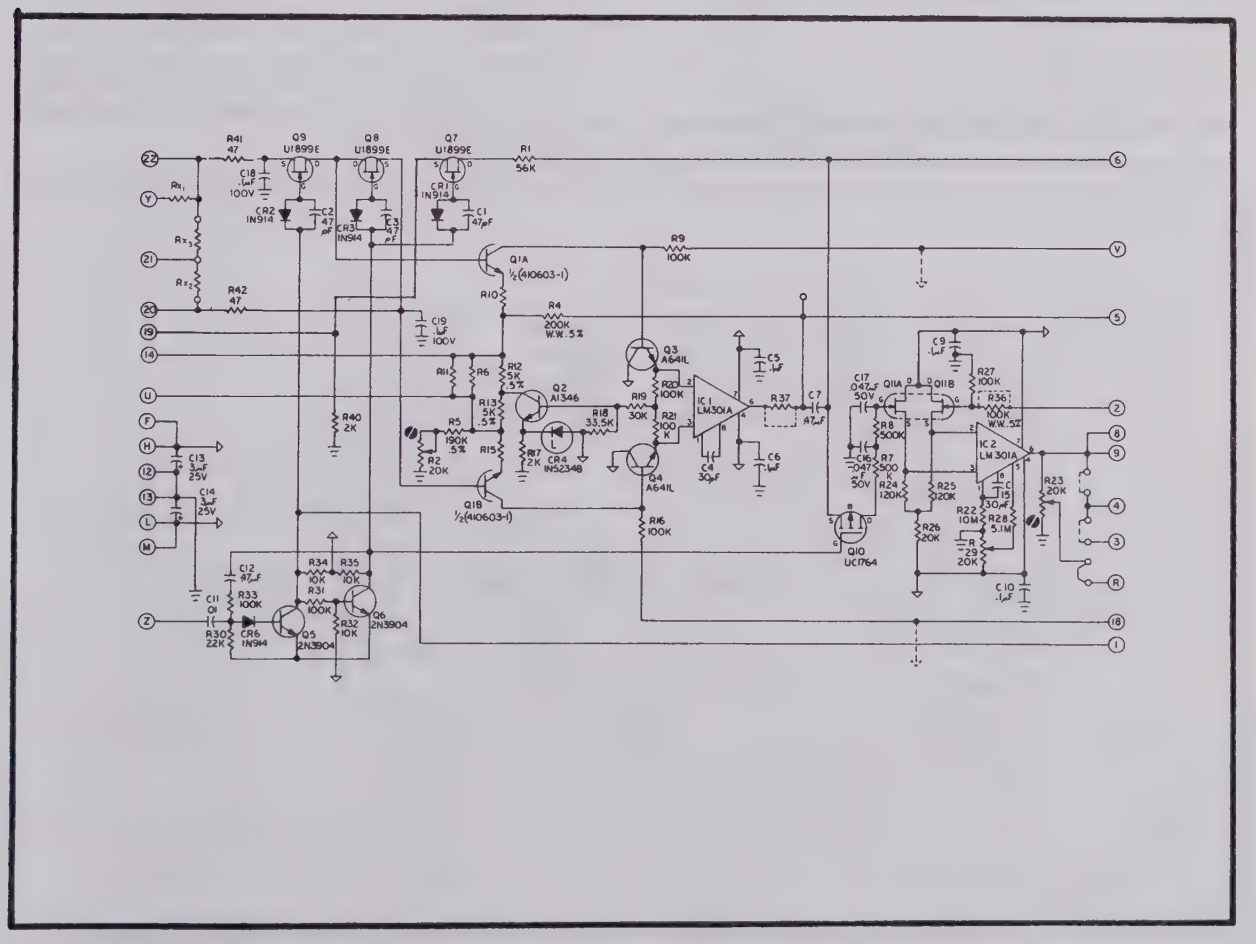


Figure 4-3. Preamplifier Circuit

4-13. The automatic zero function is controlled by the monostable multivibrator Q5, Q6. The multivibrator delivers a ±15 volt potential to the gates of Q7, Q8, Q9, and Q10 three times per second when triggered by the digital pulse from the counter circuit. The pulse is coupled into the multivibrator at pin Z. When a negative voltage is applied to the gate of Q9, Q9 opens, interrupting the input signal. Simultaneously, Q8 closes, shorting the inputs to Q1A/B; Q7 closes tieing C7 to ground; Q10 opens to hold the charge on C16 and C17, thereby preventing a spurious waveform from C7 being fed into the output circuits. C7 is allowed to charge to the level of any existing offset voltage present in the amplifier. At the beginning of the next sample time when the control multivibrator reverses the state of Q7, Q8, Q9, Q10, the stored offset voltage eliminates (bucks out) the offset voltage portion of the signal. Q10 is not present in a preamplifier that is being used with the optional active filter since the filter will be insensitive to the square wave pulse generated by C7 when Q7 closes.

4-14. Zero trim control R29; Common Mode Rejection Adjustment R2 are factory set. Refer to Section V for adjustments. Linearity control R23 is not used in the 8200.

4-15. Active Filter.

4-16. When used, the active filter, Figure 4-4, eliminates undesirable signal from low-level pulsating or cyclic loads on the transducers before signal reaches the converter. This system utilizes a three-pole active filter. Q1 is a series junction FET, the gate of which is controlled by the multivibrator in the preamplifier and accelerated by CR1 and C1. Q1 holds and maintains the signal input voltage which is further filtered by a conventional R-C network and applied to Q2, a dual FET. Q2 is similar to and performs the same function as Q11 in the preamplifier circuit. Constant closed loop feedback is provided by IC1, an operational amplifier. IC1 also acts to restore the signal level originally presented to the input of the device, compensating for small signal losses in the filter. Zero trim control R8 is factory set to maintain zero output of the filter with zero input signal.

4-17. Analog to Digital Converter.

4-18. The analog to digital converter is an integrating voltage-to-proportional-count device that provides an output pulse train. The number of pulses (counts) contained in the output train is an exact function of the unknown input signal voltage. The count output is grated to the input of the counter and latch circuit, the output of which is a parallel digital code. In addition to the count output, the converter also provides a reset command to the counter and latch and accepts a full scale count carry signal from the counter. Figure 4-5 illustrates, in pictorial form, operation of the converter. Figure 4-6 is a detailed schematic of the device.

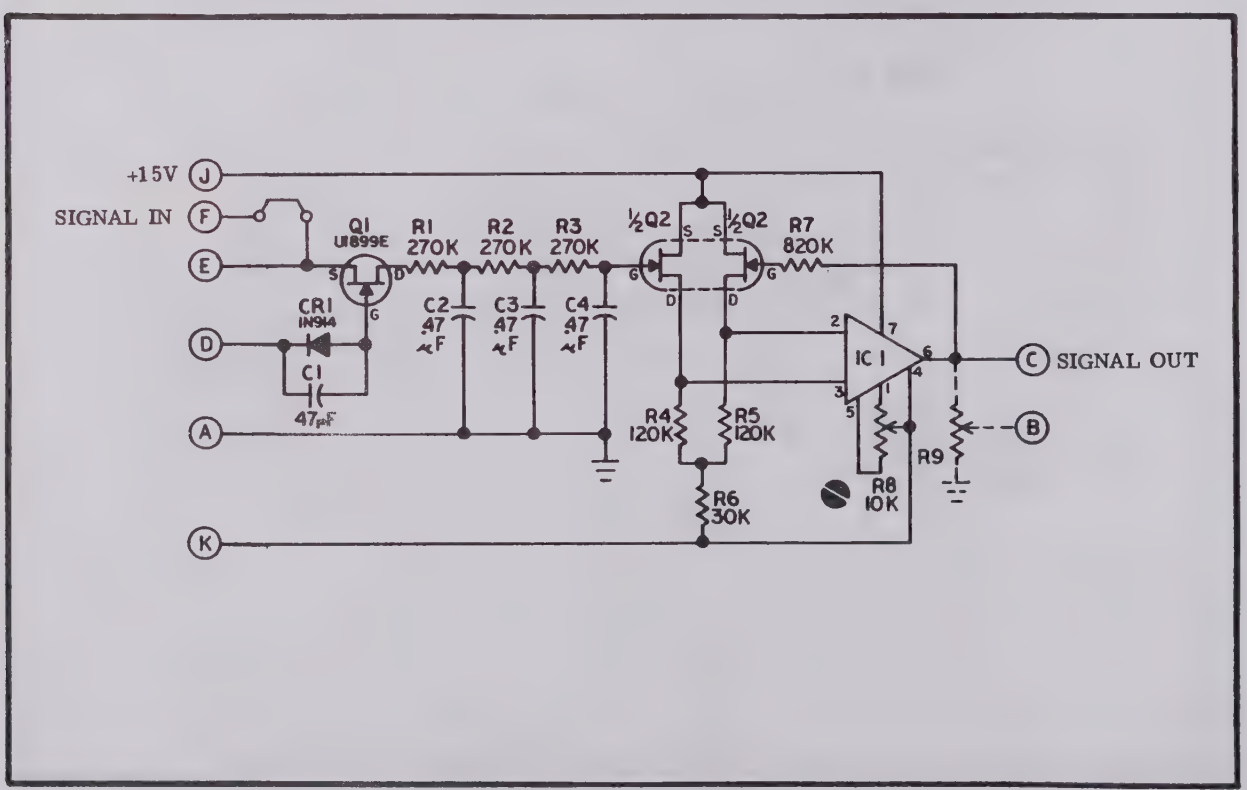


Figure 4-4. Active Filter Circuit

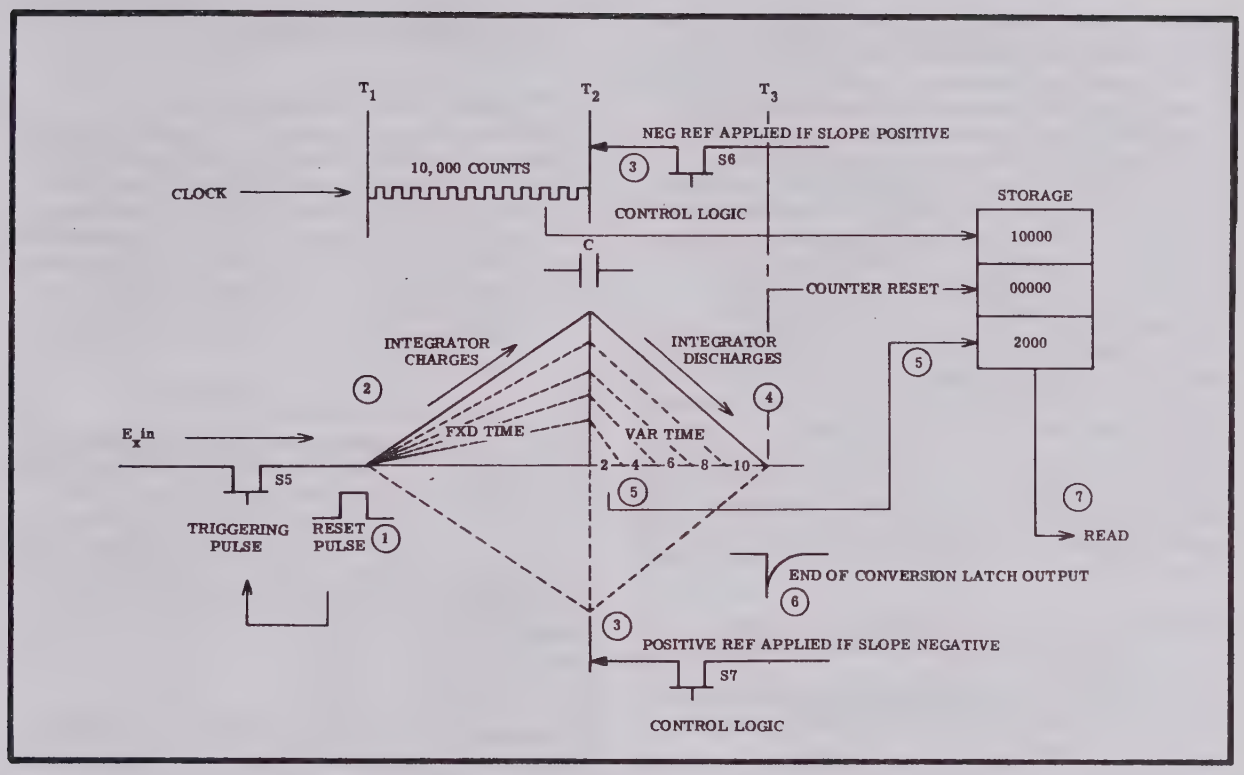


Figure 4-5. Pictorial Diagram, Dual Slope Integration

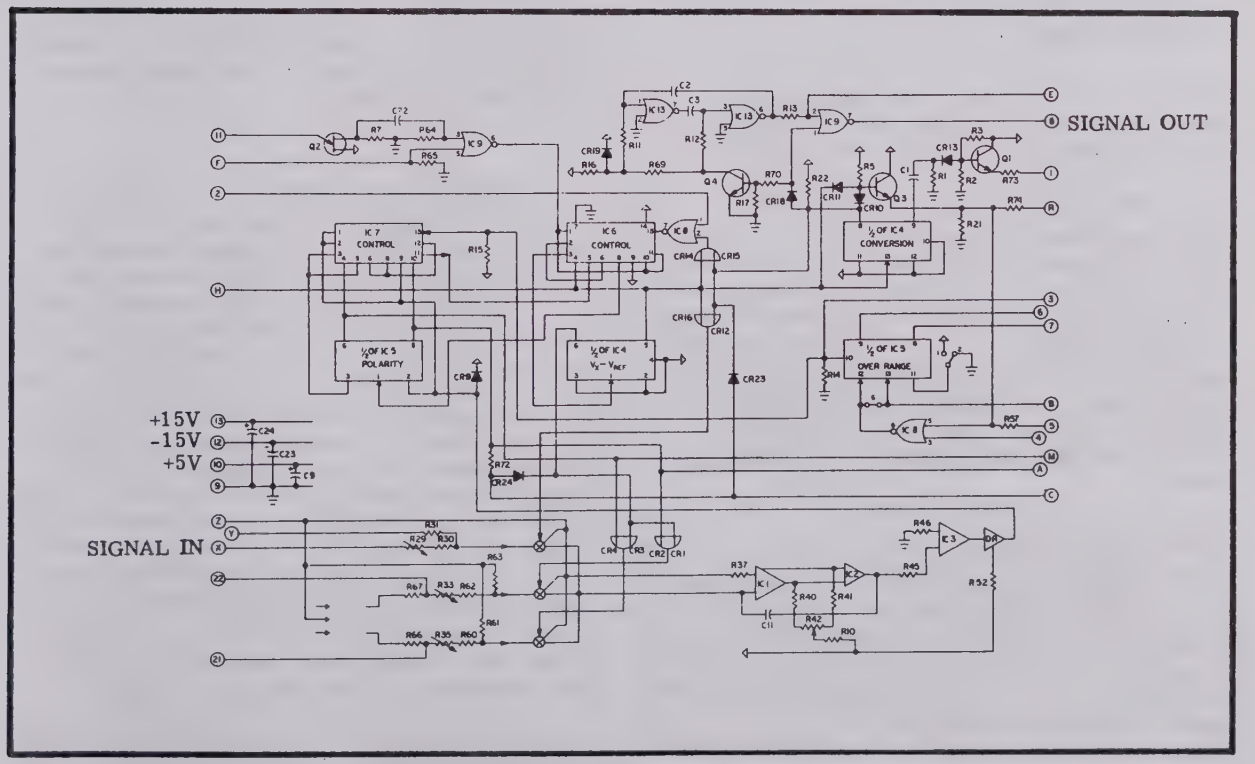


Figure 4-6. Converter Circuit

4-19. Upon command from the unjunction trigger circuit the counter is reset, S5 closes and the pulse train output from the internal clock is gated to the counter and latch circuit at the same time that integration of the unknown voltage is begun. The integrator is allowed to charge for a fixed time of 10,000 counts, filling the counter. The slope angle of integration is controlled by the magnitude of the unknown signal input voltage; the greater the voltage, the steeper the slope. When integration time is completed the full scale count carry signal is returned from the counter, switch S5 opens and a reference voltage having a polarity opposite to that of the stored integrator voltage is applied to the integrator. Application of the reference voltage discharges the integrator toward the baseline; direction of discharge (up or down) is determined by the control logic. Because integration rate of the reference voltage is a constant, the digital number (result count) remaining in the counter is directly proportional to the unknown input signal voltage. The time required for reference integration is variable (depending upon magnitude) and is equal to:

$$\text{(input integration time)} \times \frac{\text{(analog input voltage)}}{\text{full scale input voltage}}$$

For example: Full scale signal input voltage is 5V. If only half of full scale input is applied to the device,

$$10,000 \times \frac{2.5\text{V}}{5\text{V}} = 5000 \text{ or } 2.5\text{V}$$

The digital readout will indicate 5000 counts. This variable integration time is, in effect, displayed as the digital readout.

4-20. All data is present in the counter until the next trigger command which resets the counter to zero for the beginning of a new conversion.

4-21. Counter and Latch.

4-22. The counter, Figure 4-7, is composed of five identical decades. Each decade is made up of an 8-4-2-1 BCD counter and a gated latch storage unit. The counter accepts pulses from the converter and divides the frequency by 10. Output from the 8 bit is fed to the next decade; all four bits are fed to the storage unit. At the end of encoding, the four bits in the counter are transferred into the flip-flops in the storage unit which ignore any changes in the state of the counter until the next end of conversion pulse.

4-23. Digital Display.

4-24. Latch unit outputs are converted to the inputs of the decoder drivers in the display circuit. The decoder drivers contain internal logic which converts the binary input into one-out-of-ten information. Output is in the form of ten high-voltage driver lines which are connected to the ten cathodes of the side reading digital display tubes, (V1, V2, etc). See Figure 4-8.

4-25. POWER CIRCUIT ANALYSIS

4-26. Line/Filter Transformer.

4-27. Either 115 or 230 volt ac power is connected through Fuse F1 (0.3 amp. slo-blo) and the line filter which is composed of chokes L1 and L2 and capcitor C1 to the primary of power transformer T1. T1 secondary is connected to the inputs of both the +5/+180V and the ±15/+10V power supply circuits. The primaries of T1 are internally connected, as specified by the sales order, in parallel for 115 volt operation or in series for 230 volt operation.

4-28. +5/+180V Power Supply.

4-29. Voltage developed on the secondary windings (pins 10, 11, and 12) of T1 is applied to a half-wave rectifier DB2 at pins D, E, and 7 of the +5/+180 board, Figure 4-9. The rectified voltage is regulated at IC1, a positive voltage regulator used with an external PNP pass transistor (Q1). Inclusion of the external pass transistor greatly increases current output capacity of IC1 and makes available, in addition to internal demands, an external power output of +5V at 100mA.

4-30. Transformer output voltage is also applied to a full bridge rectifier DB1 at pins A and 1. The output of DB1 is filtered at C1 and R2 and produces +180V unregulated at pin B. Pin 2 is 180V common. The +5V regulated output is delivered to the converter, counter and latch, and the digital display boards for various power and control functions. The +180 unregulated voltage powers the neon digital display tubes and legend assembly.

4-31. ±15/+10V Power Supply.

4-32. T1 also supplies voltage to the ±15/+10V supply at pins E and F. This voltage is applied to the full bridge rectifier DB1, filtered by C1 and distributed to the precision voltage regulators, ICs 1, 2. IC1 operates with the unregulated -28V, filtered by C2 and is wired as a negative voltage regulator and produces -15 volts, regulated, at pins C and D of the board. This voltage is supplied to the analog to digital converter, the preamplifier, and the active filter. IC2 is a positive voltage regulator with an external NPN pass transistor, Q2 for increased current output. The +15V is utilized by the converter, the preamplifier, and the active filter. IC3 is very similar to IC2 but connected to produce +10V regulated, the transducer excitation voltage. IC3 can be adjusted with selected resistors to provide a non-standard voltage output or to compensate for transducer nonlinearities. A remote sensing circuit senses temperature induced changes in lead wire resistance and automatically increases or decreases excitation output to maintain a steady, regulated, level. Figure 4-10 illustrates the ±15/+10V power supply circuit.

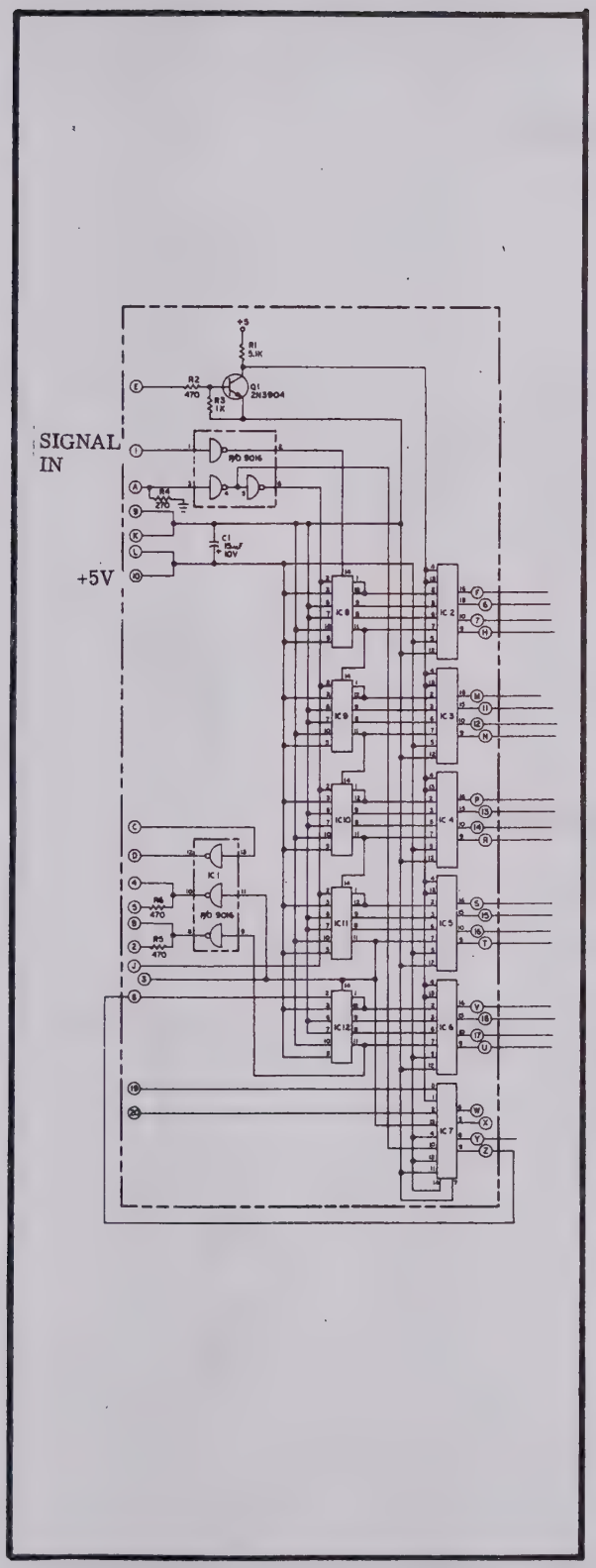


Figure 4-7. Counter and Latch Circuit

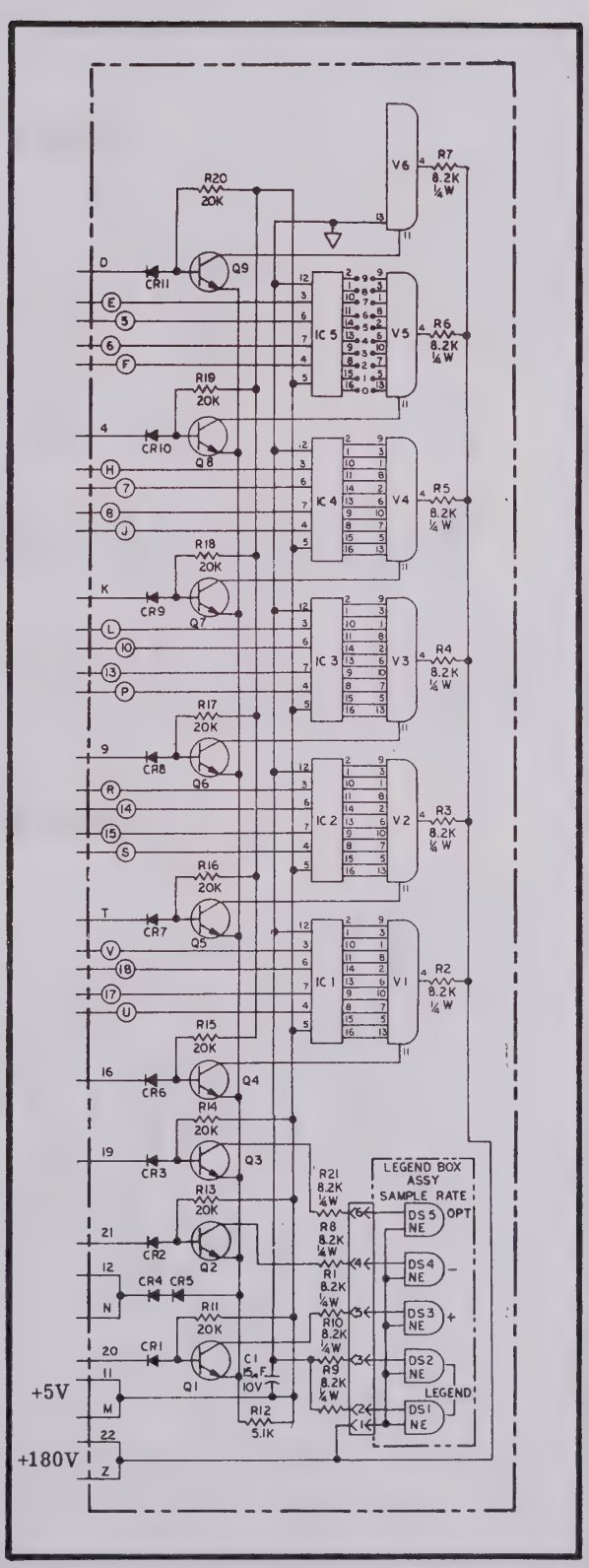
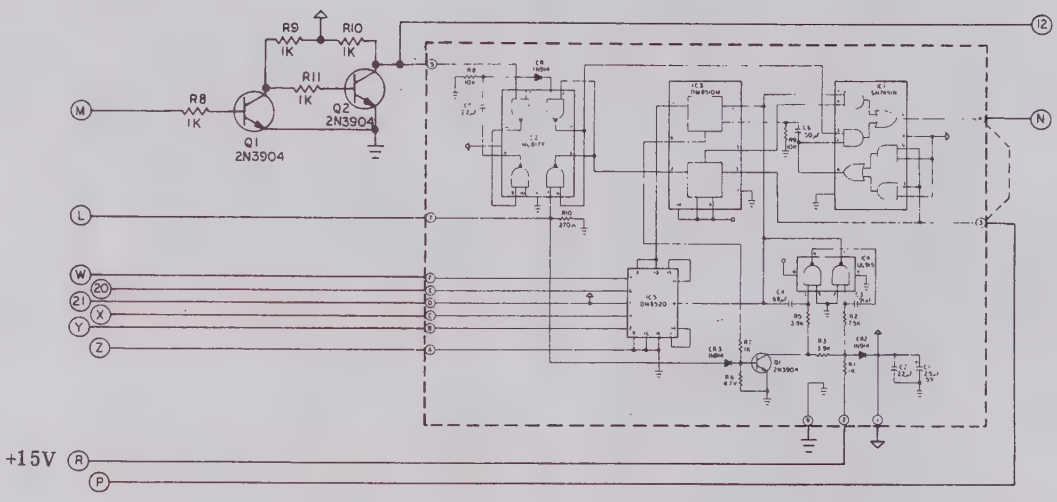


Figure 4-8. Digital Display Circuit

MULTIPLIER



POWER SUPPLY

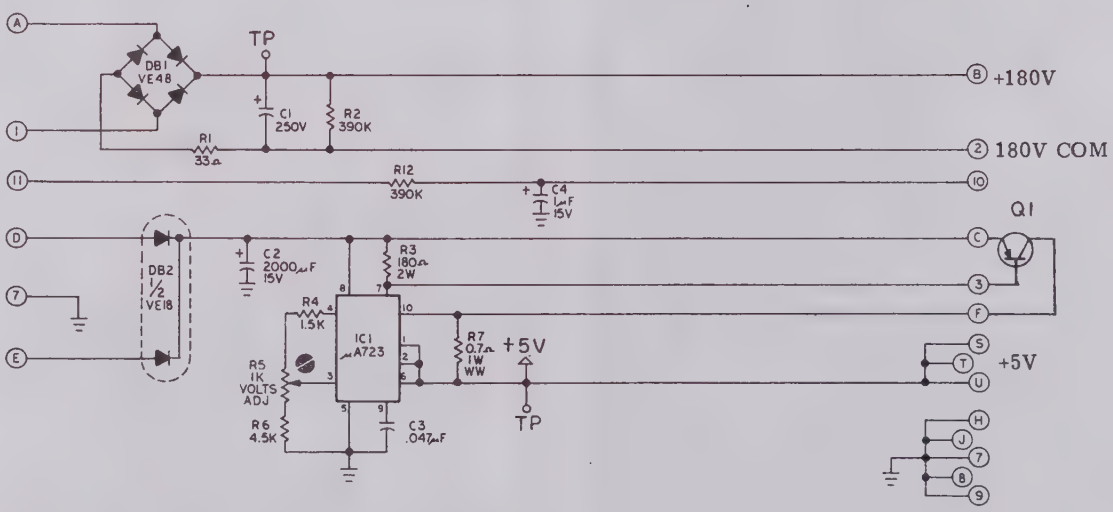


Figure 4-9. +5/+180V Power Supply Circuit

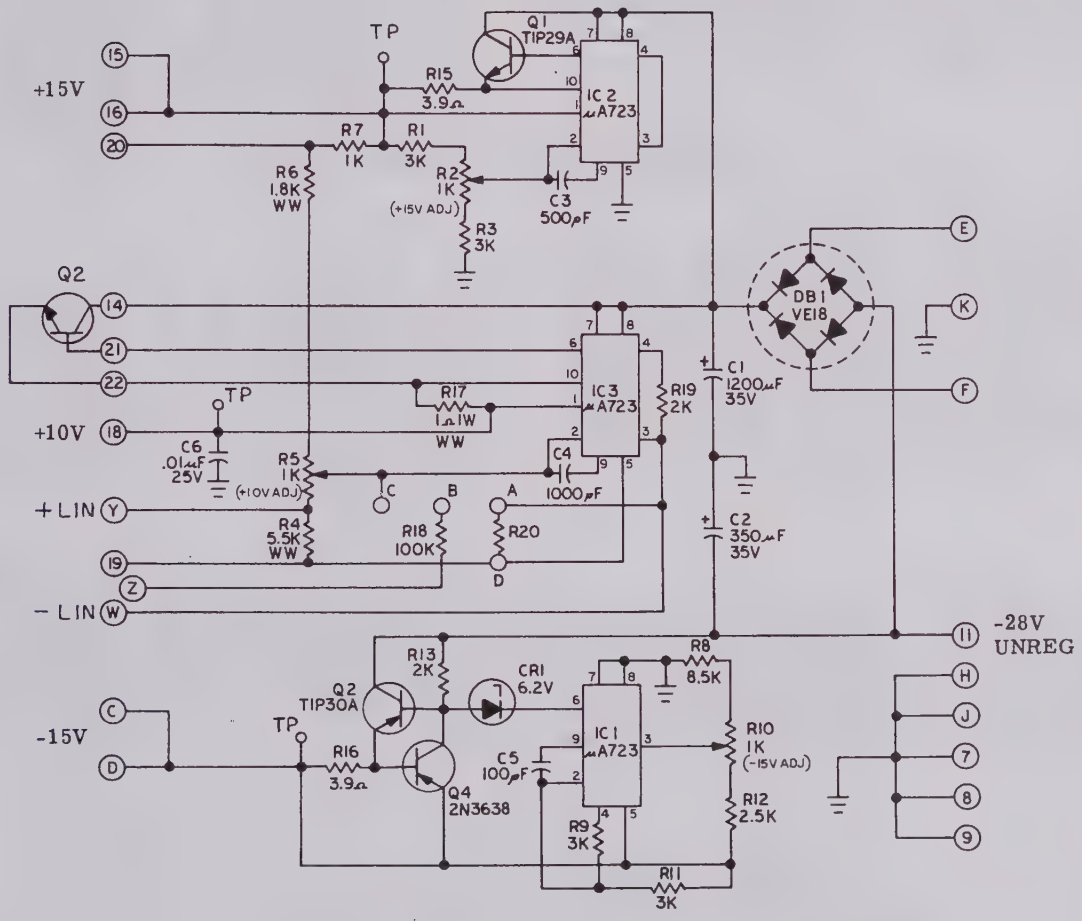


Figure 4-10. +10/±15V Power Supply Circuit

4-33. MULTIPLIER CIRCUIT.

4-34. The pulse multiplier circuit, Figure 4-9, is physically located on the +5V/+180V power supply board. Electrically, the multiplier is located between the voltage-to-counts converter and the counter. Basically, the multiplier produces a given number of pulses to the counter for every pulse coming from the converter. This technique enables a full scale signal input of 5. 000V (which would normally produce a 10,000 count readout) to indicate 20,000, 30,000, 40,000, etc counts in the digital display and still maintain full resolution. The front panel MULTIPLIER switch controls this function by supplying the required +5V or ground to the appropriate connections of connector J6.

4-35. SPAN CONTROL CIRCUIT.

4-36. The output from the preamplifier at pin 8 is connected into the Resistor Board at 16. The signal is fed back into the preamplifier directly or through R13 depending upon the MV/V INPUT selection. In the 3. 6mV/V position feedback is 100%. In the 2. 4mV/V position feedback is 70%. Maximum feedback occurs only when the AMPL SPAN control is in the counterclockwise direction. The controlled portion of the preamplifier output is fed back at pin 2 of J1. Refer to Figure 4-11.

4-37. ZERO CONTROL CIRCUIT.

4-38. Instrument zero is established by the BRIDGE ZERO control and by internal controls on the separate circuit boards. The BRIDGE ZERO control is connected between the + and -10V source in the ±15/+10V Power Supply. The voltage required for setting the zero level is applied to the preamplifier input circuit at pin Y with the MODE switch S2A in OPERATE. Refer to Figure 4-11 and to the Maintenance section for adjustment of the internal zero controls.

4-39. LINEARITY CONTROL CIRCUIT.

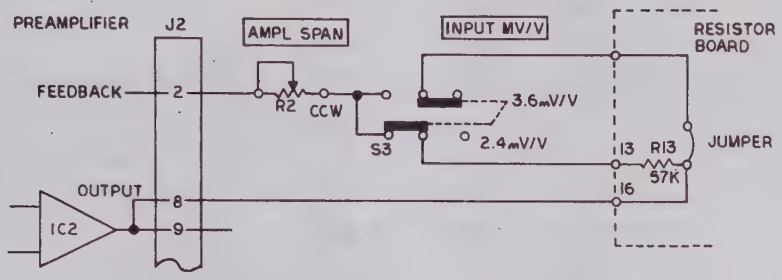
4-40. The linearity of the output signal is adjusted by applying voltage of the correct polarity to offset the nonlinearity. This control operates with the SPAN control to shape the output for the best straight line fit, zero to full scale. The LINEARITY control is connected between the + and - sides of the control integrated circuit IC3. This voltage is approximately 7V. Impressed across the 100KΩ LINEARITY control, a portion of the 7 volts can be applied with the correct polarity to offset tension or compression nonlinearity.

4-41. CALIBRATION CIRCUIT.

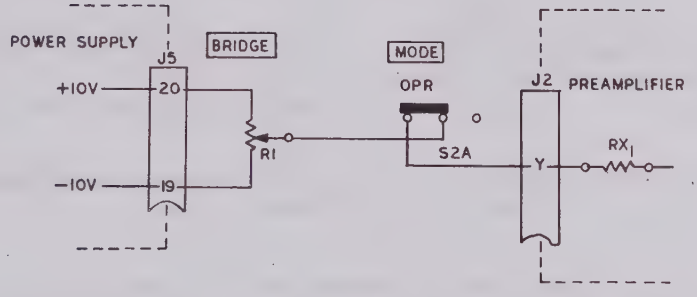
4-42. The calibration circuit shown in Figure 4-12 consists of the star bridge R4, R5, R8, and R9 and the offset resistors R6 and R7. The bridge is excited by approximately ±10V from the ±15V Power Supply to provide a precisely balanced bridge. The output is applied through the MODE switch in the ZERO mode and into the Preamplifier input at J2, pins 20 and 22. The instrument is adjusted with the zero input for a zero output.

4-43. When the MODE CAL switch is closed an offset voltage is generated across R6 and R7 to unbalance the bridge. The precise unbalance signal is connected through the CAL section of the MODE switch into the Preamplifier input at J2 pins 20 and 22 to provide an input signal for adjusting the span of the instrument. Both zero and cal signals are disconnected from the circuit when the MODE switch is in OPR.

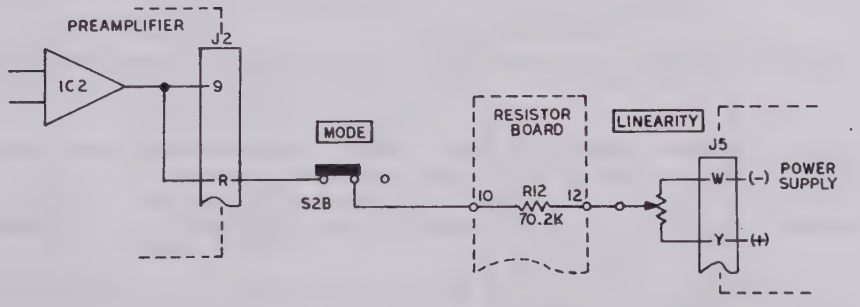
CONTROL CIRCUITS



SPAN CONTROL CIRCUIT



BRIDGE ZERO CONTROL CIRCUIT



LINEARITY CONTROL CIRCUIT

Figure 4-11. Control Circuits

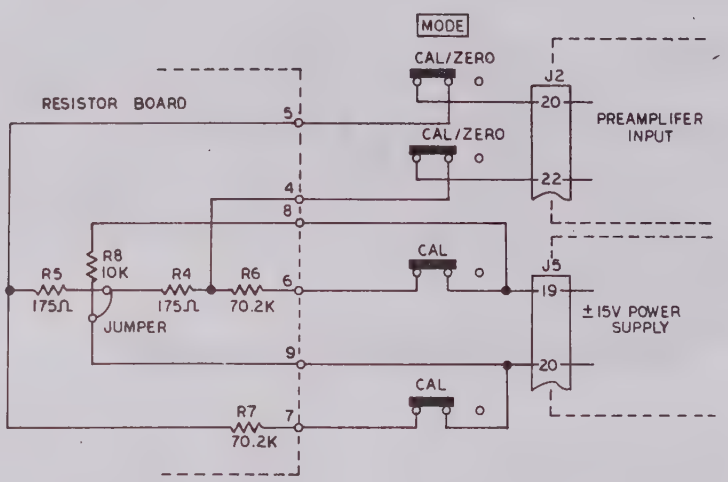


Figure 4-12. Calibration Circuit

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. General.

5-3. This section provides the information and outlines the procedures necessary for the proper maintenance and service of the Model 8200 Calibrator Indicator. Information includes preventive maintenance (Paragraph 5-6 through 5-13), troubleshooting (Paragraphs 5-14 through 5-27), repair and replacement of components (Paragraphs 5-28 through 5-41), and calibration and adjustment (Paragraphs 5-42 through 5-57). Test equipment recommended for checking and troubleshooting the instrument is listed in Table 5-1. Test instruments other than those listed can be used providing the performance equals or exceeds the required specifications.

5-4. Cover Removal.

5-5. Removal of the top cover exposes the circuit area shown in Figure 5-2. It will be necessary to remove the top cover for access to the test points (Figure 5-3) and for the replacement or installation of printed circuit boards and individual components. On most instruments, the top cover is removed by simply sliding it to the rear. If the cover does not slide easily, work a narrow bladed screwdriver between the rounded lip at the rear of the cover and the side frame of the instrument as shown in Figure 5-1. Pry rearward gently until the cover moves approximately 1/4 inch. Repeat procedure on opposite side. Alternate from side to side until friction is broken and cover slides easily. Normally it will not be necessary to remove the bottom cover of the instrument.

WARNING

115/230V AC AND DC SUPPLY WIRES ARE EXPOSED WHEN INSTRUMENT COVER IS REMOVED. EXERCISE CAUTION DURING TROUBLESHOOTING, ADJUSTMENT, OR REPAIR.

Table 5-1. Recommended Test Equipment

TYPE	CHARACTERISTICS	USE	RECOMMENDED
Calibrator	Output accuracy at each point 0.1% or ±0.0003mV/V whichever is greater.	Troubleshooting, Calibration	BLH Model 625 Precision Calibrator
AC DC VTVM	1mV to 100V, 10 megohm impedance.	Troubleshooting, Adjustment	
Decade Resistor	Total resistance, 10,000 ohms multiple of 1 ohm 0.05% accuracy.	Troubleshooting	
Multimeter	1% accuracy at full scale input impedance 100 megohms	Troubleshooting	Hewlett Packard Model 414A
Oscilloscope	200kHz bandwidth	Calibration, Troubleshooting	
Variable Power Transformer	0-230Vac	Troubleshooting	VARIAC
Standard Dead Weights	Class C or better - capacity to suit system.	Calibration	

5-6. PREVENTIVE MAINTENANCE.

5-7. Cleaning.

5-8. The Indicator is enclosed in a vinyl-coated aluminum cabinet and should be cleaned only with a damp cloth moistened in a solution of warm water and mild detergent. Do not use any chemical solvents or abrasive cleaners on the vinyl case or anodized aluminum surfaces. Use a soft brush to remove external dust accumulation. Loose dust within the chassis can be removed with dry, low-pressure, compressed air or a small vacuum cleaner. Contamination of the switches, circuit boards, or edge connectors will cause high impedance leakage paths and subsequent deterioration of instrument performance. Avoid touching any of these circuits with the bare fingers, as skin oils are extremely contaminating. Do not use a pencil to trace circuits in the instrument. Graphite pencil lead is an excellent conductor; an accidentally introduced path of this type is often difficult to locate. If printed circuits do become contaminated during troubleshooting or replacement, clean with a weak solution of warm water and mild detergent. Rinse thoroughly with clean water and allow to dry completely before operating. Do not use alcohol or any other cleaning solution except detergent and water. PC board edge connections can be cleaned with a fiberglas brush, if available, or with an ordinary pencil eraser as indicated in Figure 5-4.

CAUTION

DO NOT USE COMMERCIAL MOISTURE SEALING SPRAYS ON THE BOARDS. APPLICATION OF THESE AGENTS WILL CAUSE LEAKAGE PATHS AND SUBSEQUENT DETERIORATION OF INSTRUMENT PERFORMANCE.

5-9. Lubrication.

5-10. The pushbutton POWER and MODE switches are the only moving parts in the instrument. Each switch module has been lubricated during assembly and does not require further lubrication during normal operation. During continuous operation in extremely dusty environments however, an occasional application of a commercial spray cleaner such as Miller-Stephenson MS-230 Contact Re-Nu, will lubricate and clear the switch contacts of possible contamination. Apply cleaner/lubricator through an extension nozzle at the rear of the switch stator block as shown in Figure 5-5.

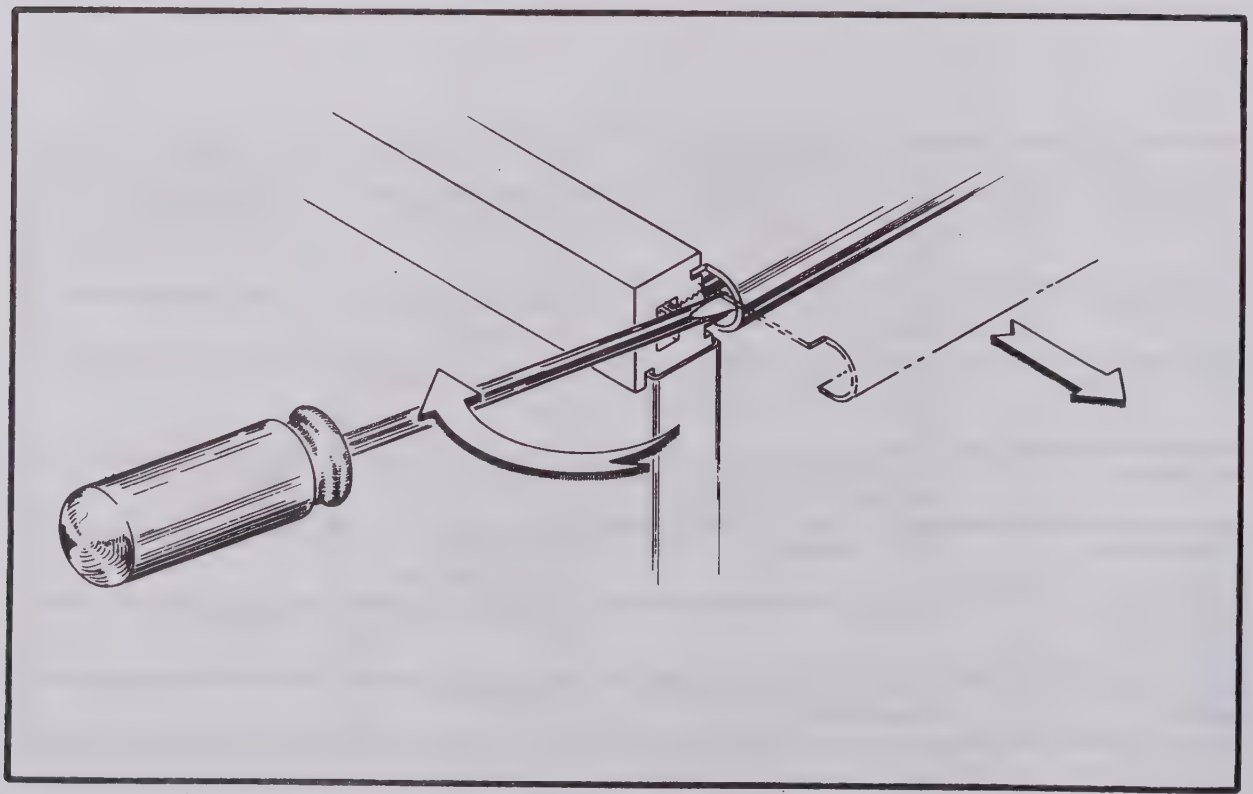


Figure 5-1. Cover Removal

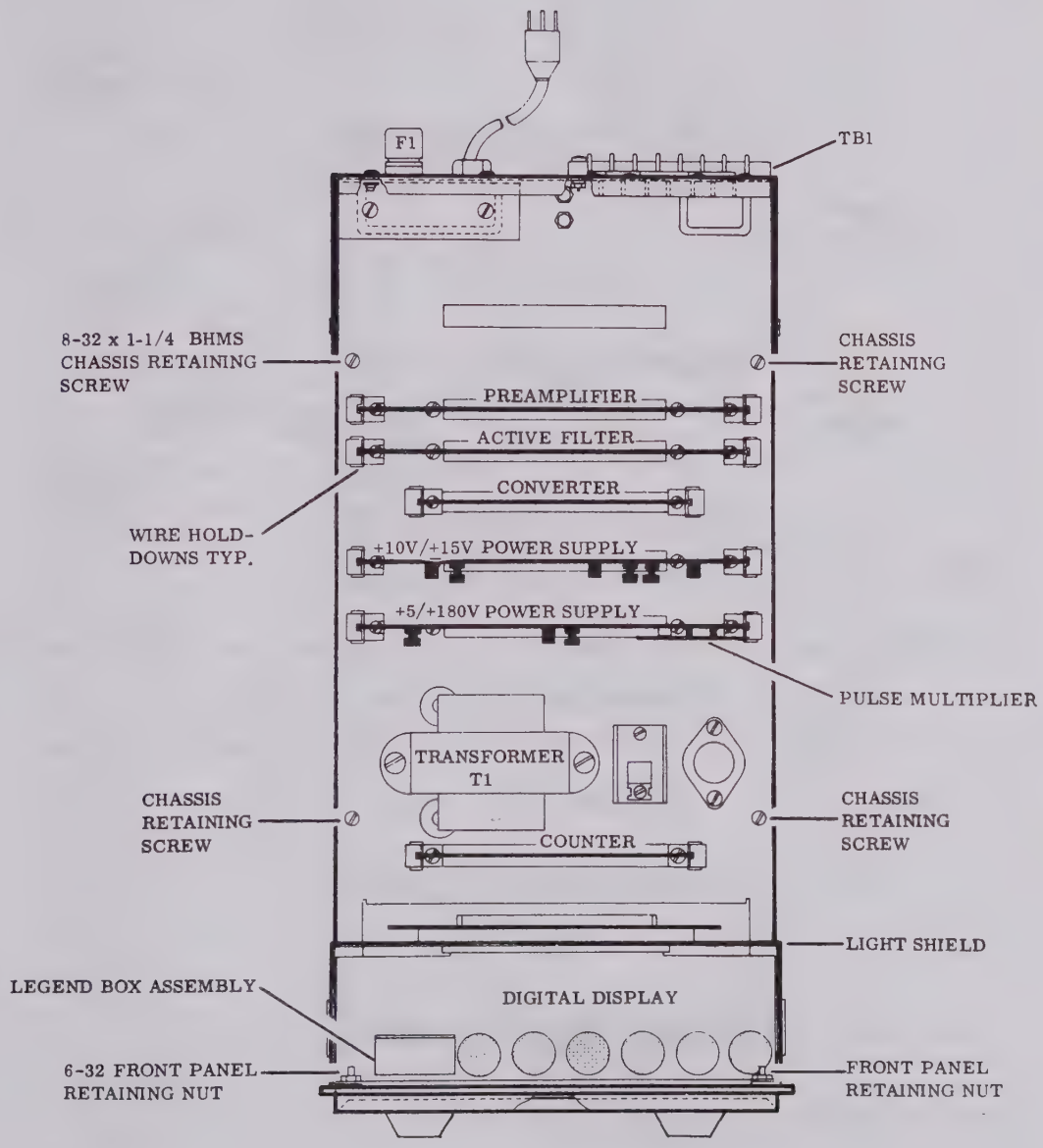


Figure 5-2. PC Board and Component Location

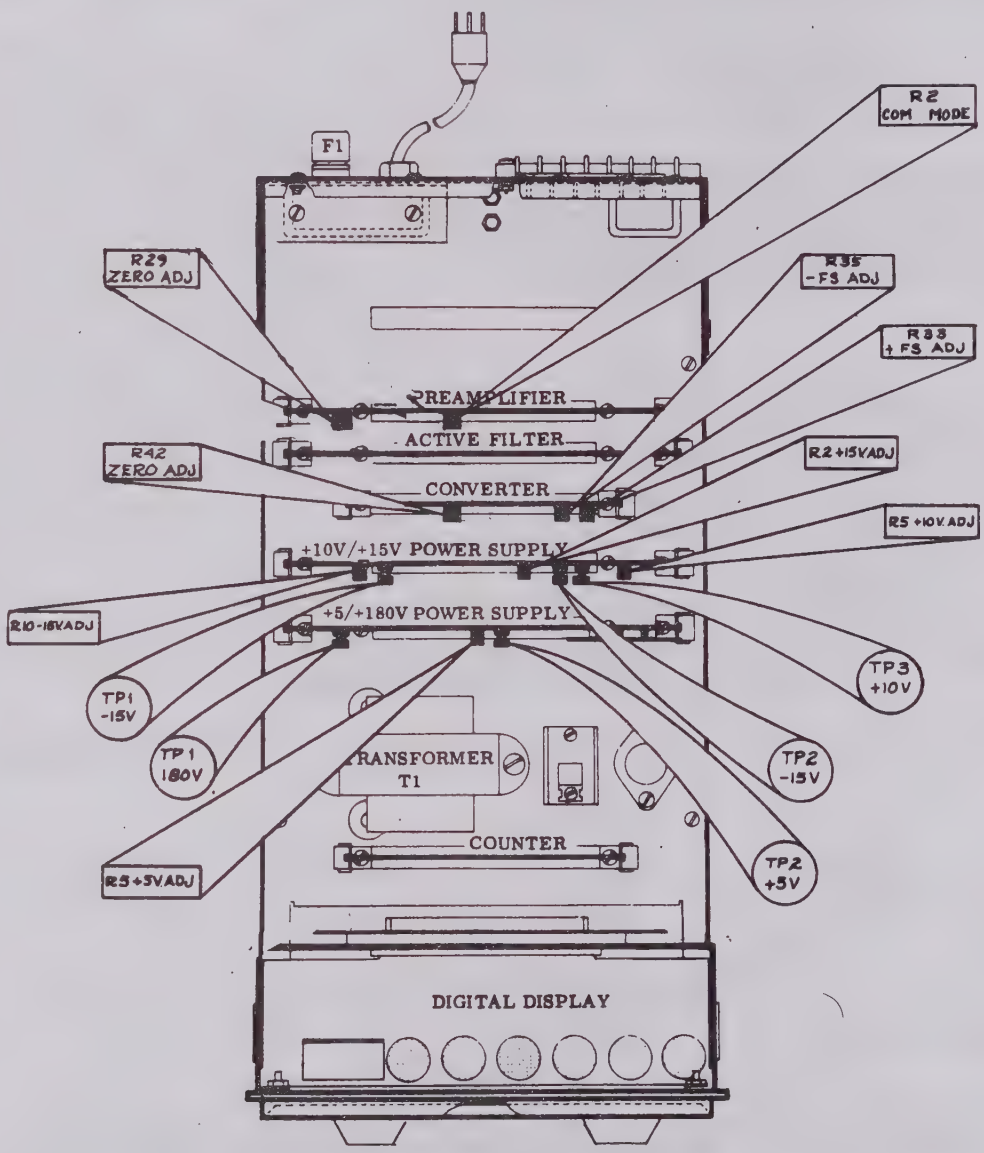


Figure 5-3. Test Point Location

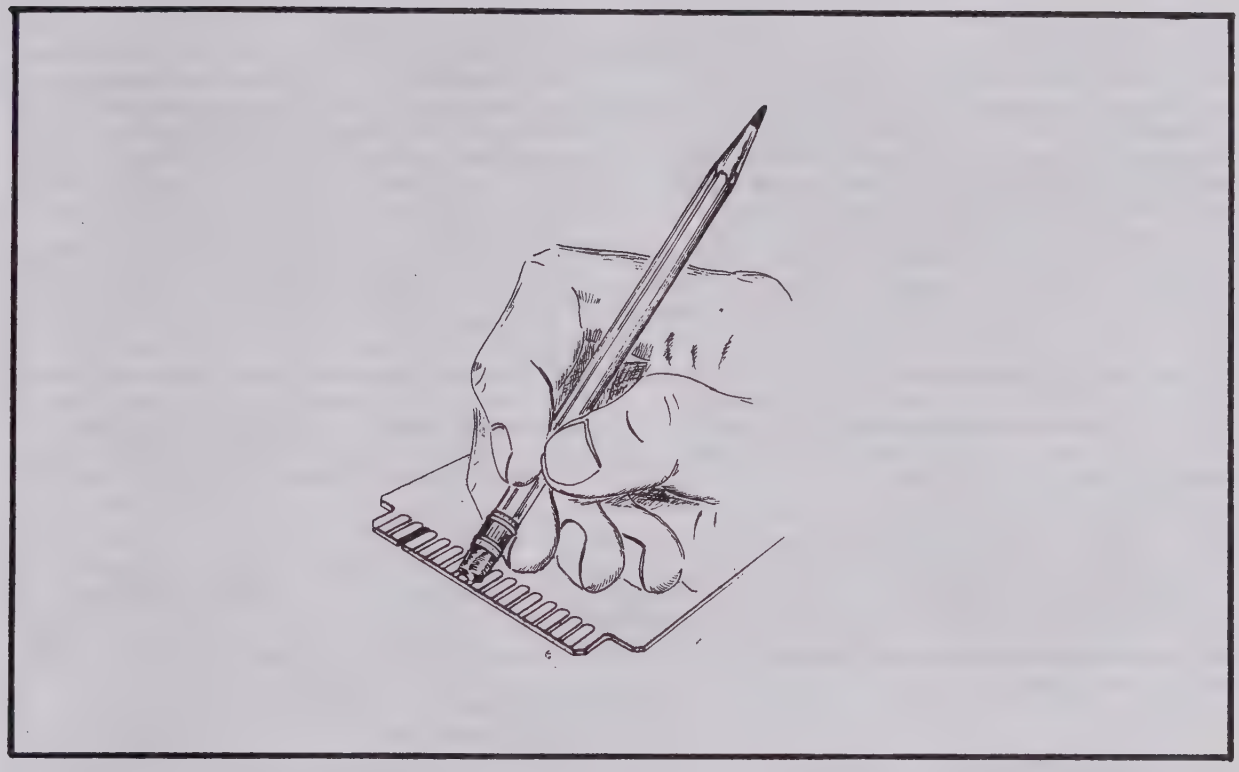


Figure 5-4. Cleaning PC Board Edge Connectors

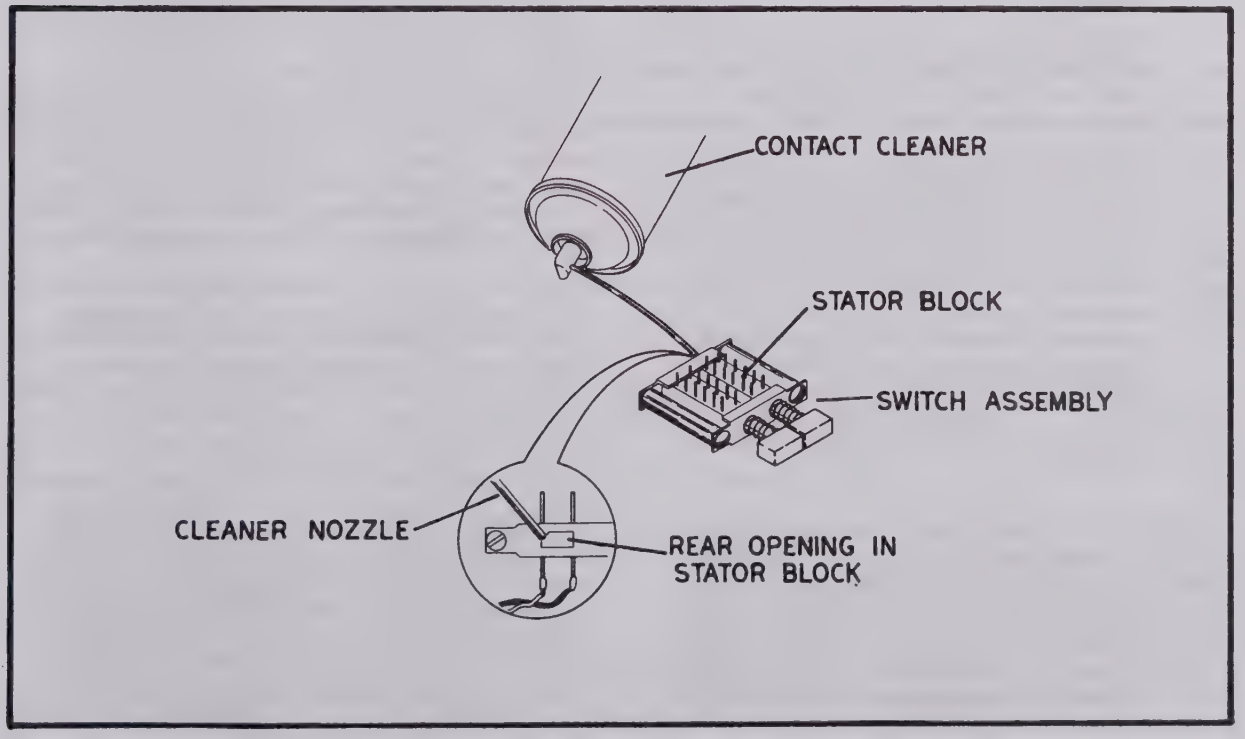


Figure 5-5. Switch Lubrication

5-11. Periodic Check.

5-12. BLH recommends that the entire system be performance tested on a quarterly basis (500 hours) if possible. In process applications, where 24 hour operation is common, performance test the system during scheduled maintanance/cleaning downtimes or whenever possible. The calibration check (Section III) provides a valid check of instrument performance that can be performed without disrupting normal system operation. The instrument can be returned to BLH for a thorough overhaul whenever necessary and checked with test instruments traceable to the National Bureau of Standards. If user maintenance and calibration is not feasible, or if unusual problems or applications are encountered, a visit by a BLH Field Service Engineer can be arranged through any of the Sales/Service offices listed at the rear of the manual.

5-13. FACTORY SERVICE. If factory service is required, the instrument must be accompanied by the RETURN AUTHORIZATION FORM 862. Upon examination of the instrument at the factory, a full report on the instrument condition along with a quotation on repair cost (if not under warranty) and delivery time will be submitted to the customer before work is begun.

5-14. TROUBLESHOOTING.

5-15. Preliminary.

5-16. The troubleshooting techniques discussed in the following paragraphs apply only to 8200 Indicators used as other than Calibration Kits. The basic tools for troubleshooting are the schematic diagram at the rear of the manual, the theory information in Section IV, and the Troubleshooting Aid, Table 5-2, in this section. The most effective method of troubleshooting is to sectionalize the malfunction to a specific unit before attempting to localize the problem to a particular circuit or stage. Table 5-2 contains a summary of front panel symptoms that usually indicate the malfunction of a specific component or board; check before continuing troubleshooting process. Test point location and voltage limits at each point are illustrated and listed in Figure 5-3. Use of the extender board (BLH# 411621-2, available as an accessory) facilitates checking of PC board mounted circuits.

5-17. SUBSTITUTION. Troubleshooting is greatly simplified if checking is done by replacing assembly suspected of malfunction with a spare unit known to be operating correctly. Where the malfunctioning assembly is found, the faulty component can be replaced if practicable or the entire assembly shipped to a BLH Sales/Service Office for repair or replacement. Calibration Kits should be returned to BLH for repairs and recalibration.

5-18. External Circuit.

5-19. Substitution of a BLH Model 625 Calibrator for the transducers (Figure 5-6) at the rear panel of the indicator will sectionalize the trouble to the transducers, junction boxes, cabling and connections, or indicator. Set the calibrator to the output desired and check indicator readout. If the indicated output is correct for the range and step selected, the trouble lies with the external circuit. Inspect length of cable for breaks, cuts, or bruises. Check cable continuity in a weighing situation by moving the cable at the connector and by bending the cable in short loops, while an observer monitors the indicator. If indicator readings are erratic or intermittent, replace entire cable assembly or transducer. If the transducer(s) appears to be faulty, refer to the appropriate transducer operating and service manual for troubleshooting resistance and leakage data.

5-20. Power Circuit.

5-21. UNLIT DISPLAY. (If display is lit go directly to Paragraph 5-22). If the display is unlit, begin with the power source and power cable. Check that instrument is plugged in and that power source voltage is reaching the receptacle; check power cord for breaks, cuts, and bruises. If power cord is intact, check fuse F1. If F1 is blown, carefully inspect the electrical connections in the system for shorts before replacing with a 0. 3 ampere 250V time delay fuse (BLH# 128552-8, Buss MDL 0. 3). Check positioning and functioning of POWER switch S1 by shorting the terminals with a test lead jumper. Transformer T1 can be checked in the instrument. Measure all voltages at the secondary windings of the transformer with line power applied to the primaries. If the voltages check with those given on the schematic diagram and there are no primary-to-secondary short circuits, the trouble should be confined to either the +5/+180V or the ±15/+10V power supply board. If the pulse multiplier option is not used, check that pins 3 and 4 on the +5/+180V board (see Paragraph 5-24) are jumpered. Continue below.

5-22. LIT DISPLAY. (The following also applies to unlit displays after proceeding through Paragraph 5-21). If the display is lit, the power circuit through Transformer T1 can be eliminated as a potential trouble source; begin troubleshooting at the +5/+180V power supply board. If pulse multiplier option is not used, check that pins 3 and 4 are jumpered. Check voltage at TP1 (+180V) and TP2 (+5V). Pin 2 is 180V common. The junction of C2 and C1 (+ side of C2) is a convenient 5V common. Unregulated voltage output at TP1 should range from approximately 180V loaded to approximately 200V unloaded. Regulated voltage output at TP2 should be +5 volts, ±5%, over the specified line operating power of the instrument. Repeat above procedure at test points 1, 2, and 3 of the ±15V/+10V power supply board. Voltage output at TP1 should be -15V, regulated; at TP2, +15V regulated; at TP3, +10V regulated. All should be within ±5% of specified values.

Table 5-2. Troubleshooting Aid

SYMPTOM	PROBABLE CAUSE	REMEDY
General non-performance, erratic, or incorrect operation.	Loose PC boards.	Push each board down firmly before continuing trouble-shooting procedure.
Blank (unlighted) display.	Pins 3 and 4 on +5/+180V Power Supply Board open. Fuse F1, line switch, power transformer.	Jumper pins 3 and 4 Replace defective components.
Superimposed digits.	IC drivers.	Replace defective driver.
Display drifts.	Auto-Zero circuit.	Replace preamplifier board.
Frozen display (no response to signal).	E1-E2 open, external sampling rate control (if used) or transducer defective.	Jumper E1 and E2, replace external sample rate control, or transducer.
Saturated display in excess of overrange (over 17,000 counts).	Defective transducer or transducer cabling. Signal input or signal circuit open.	Check signal circuit.
Display indicates 00000 (no gain)	Shorted signal input.	Check signal input circuitry and transducers.
Individual digits displayed erratically.	Decoder.driver.	Replace defective driver.
Improper tracking (poor linearity)	Transducer or preamplifier.	Replace cell with 625 Calibrator; if condition remains, replace preamplifier.
Intermittent or erratic operation.	Contaminated edge connectors.	Clean boards (Paragraph 5-7).
Loss of multiplier (digital scaling) function.	Defective pulse multiplier assembly (+5/+180V power supply board).	Replace multiplier assembly or +5/+180V power supply board.

5-23. If voltages are out of spec or non-existent, push down firmly on the board and recheck the voltages. If results are negative, give the board a thorough visual inspection. Look for loose components or similar conditions which would indicate a trouble source. If no obvious fault is indicated during the visual inspection, replace the board as a unit. See Paragraph 5-40 before repairing any printed circuit board.

5-24. PULSE MULTIPLIER CIRCUIT. (optional). A malfunctioning pulse multiplier assembly will be indicated by an unlit digital display or by the failure of the display to indicate a most significant digit other than 1. If the display is unlit, and the +5V/+180 power supply board is producing specified voltage, bypass the pulse multiplier by jumpering pins 3 and 4. If the display lights when pin 3 and 4 are jumpered, replace the multiplier.

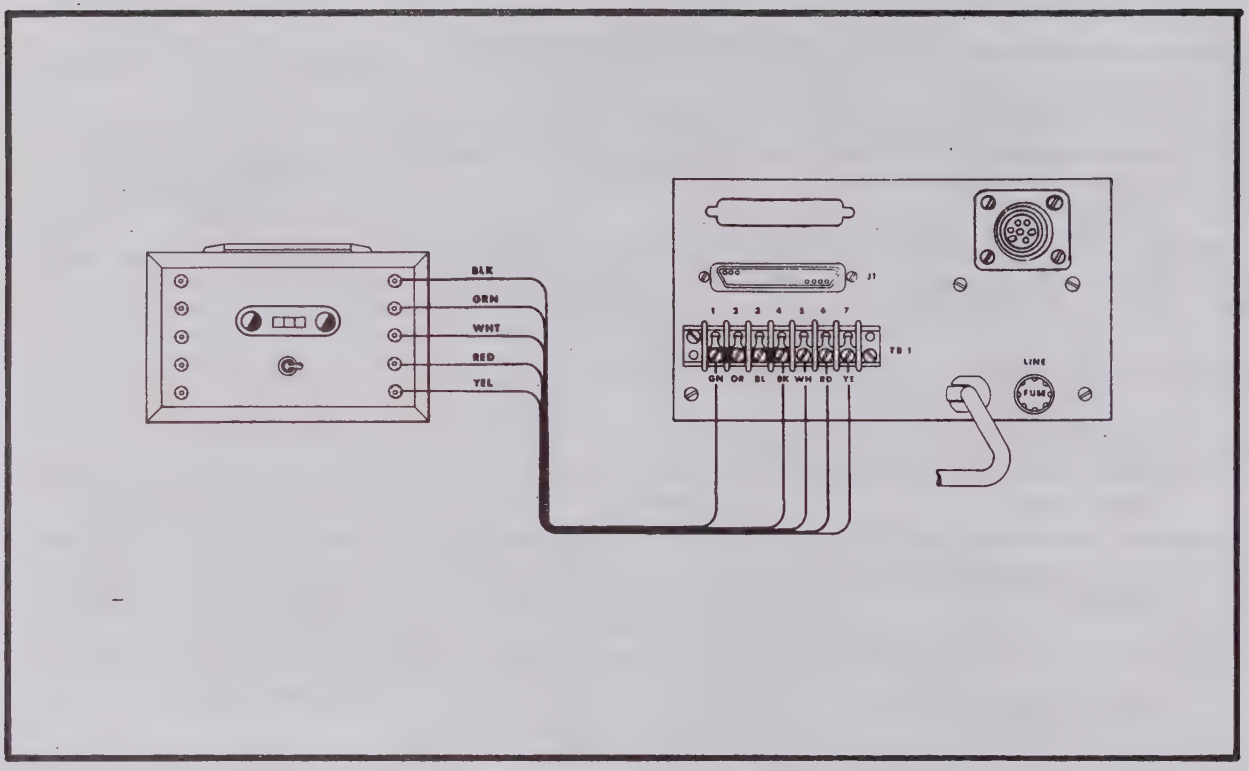


Figure 5-6. 625 Calibrator Connections

5-25. Signal Circuit.

5-26. Generally, a malfunctioning signal circuit component (preamplifier, active filter (optional); A to D converter, counter and latch, and the digital display boards) can be identified by one or more of the characteristic symptoms listed in Table 5-2. A thorough understanding of the operation and function of each circuit (see Section IV) will help in diagnosing malfunctions not immediately apparent from front panel indications. If malfunction is not listed in Table 5-2, disconnect the transducers and substitute a known signal input e. g. 625 Calibrator. Plug the instrument into a variable power transformer (Variac) and gradually lower the power input voltage to the lowest specified operating limit (103V for 115V instruments). This procedure will often cause marginal assemblies to fail completely or to indicate a malfunction listed in Table 5-2.

5-27. If the previous procedures are not effective, attempt to localize the malfunction by substitution (Paragraph 5-17). Once identified as faulty, inspect the board for obvious, easily repairable, defects such as loose components or foil breaks. Some of the signal circuit boards contain plug-in ICs (flat-packs). It is sometimes possible to determine a faulty IC by close inspection or by substitution. Carefully inspect the gold plating on the IC leads. It must show no peeling or blistering and there must be no evidence of corrosion on the body of the lead. If the general appearance is satisfactory, swap the suspected IC for another of the same type (each board with replaceable ICs has at least two (2) of the same type) and check performance. If different conditions or symptoms result or if symptoms are reversed (superimposed digits shift to next tube when drivers are switched) replace if available or order new IC.

5-28. REPAIR & REPLACEMENT.

5-29. Field Replaceable Items.

5-30. BOARD REPLACEMENT. All of the instrument signal and power supply circuits are mounted on easily replaceable plug-in PC boards. With the exception of the digital display board, all are removed by snapping the wire hold-downs outward, grasping the board by the edges and drawing straight upward. Before removing any PC board, disconnect instrument power to avoid the possibility of accidentally shorting adjacent board components.

CAUTION

WHEN INSPECTING BOARDS DO NOT TOUCH EDGE CONNECTORS OR THE ETCHED CIRCUIT TRACE. DO NOT TRACE SIGNAL PATHS OR TEST COMPONENTS FOR LOOSENESS WITH A PENCIL AS IT IS POSSIBLE TO INTRODUCE HIGH IMPEDANCE LEAKAGE PATHS WITH GRAPHITE. (see paragraph 5-8).

Replacement of the digital display board requires that the front panel of the indicator be dismounted. Proceed as follows:

a. Unplug instrument.

b. Remove top cover (Paragraph 5-4).

c. Locate and unscrew four (4) 8-32 x 1 1/4 BHMS chassis retaining screws (see Figure 5-2).

d. Slide chassis slightly forward until it protrudes about 2" from the case.

e. Unscrew the top two (2) 6/32 front panel retaining nuts with a nutdriver.

f. Carefully hold the chassis in place, turn the instrument upside down, and unscrew the two (2) bottom 6/32 front panel retaining nuts with an open end wrench.

g. Turn instrument upright; locate and unscrew the adjustment bracket retaining screw holding the display board.

h. Disconnect the board from connector J8 and draw forward out of chassis. Reassemble in reverse sequence.

All PC boards have been keyed to prevent insertion in wrong connector or backwards. (General rule: component side of boards always face to front of instrument). It is possible, however, for the key, a small phenolic chip, to be pulled out of the connector. If the chip is accidentally removed or if the connector is replaced, reinsert the key according to the Keying Chart, Table 5-3.

5-31. The pulse multiplier board is mounted on the +5/+180V power supply board with two (2) 4-40 x 1/4 binder head machine screws. To replace, remove the +5V/+180V power supply board and place foil side down on an insulated surface. Clip a heat sink (long nose pliers, heat sink tweezers, etc) to a pulse multiplier jumper between the turret lugs. Place a low-heat soldering iron with a small tip directly on the multiplier board turret and pull up on the lead. Continue working around the perimeter of the board until all jumpers are disconnected. Unscrew the two (2) 4-40 x 1/4 BHMS and lift pulse multiplier board off the spacers. Mount the replacement board on the spacers and fasten with the retaining screws. Solder the jumpers to the turret lugs according to the jumpering sequence shown in Figure 5-7. Jumpering for desired multiplier function (X1, X2, X3, etc) can be performed at the multiplier board or at the rear panel mating connector J1. See Figure 2-8 in Section II for reference.

5-32. IC REPLACEMENT. The only field replaceable ICs in the instrument are the plug-in flatpacks. Vertically mounted PC boards will have to be removed from the instrument to allow replacement of the integrated circuit modules; it is not necessary to remove horizontally mounted boards. ICs should be removed with a commercially available extractor tool (Augat, Inc. #T114-1 - see Figure 5-8). If a commercial extractor tool is not available, a substitute can be easily fabricated from a piece of scrap aluminum or steel. When removing ICs, (disconnect power from the instrument if PC board is not removed) grasp ends of module with tool or fingers and draw steadily upward until leads are free of socket. Do not bend leads. Before replacing an IC, check for proper alignment and polarity. The notch or depression in the end of the IC module must be positioned toward the socket end with the beveled corner as shown in Figure 5-9. Line replacement IC up with socket holes, set lightly into place and level carefully. Place thumb squarely on IC and press firmly into place.

Table 5-3. Keying Chart

CONNECTOR NO.	KEYING BETWEEN PINS:
J2	———
J3	———
J4	1-2 and 5-8
J5	———
J6	9-4 only
J7	2-3 and 8-9
J8	———

5-33. DISPLAY TUBE REPLACEMENT. Replacements of digital display tubes necessitates that the chassis be partially removed from the case. Proceed according to the following sequence:

a. Unplug instrument.

b. Remove top cover (Paragraph 5-4).

c. Locate and unscrew four (4) 8-32 x 1 1/4 BHMS retaining screws (see Figure 5-2).

d. Slide chassis forward until the readout tubes are accessible.

e. Pull and replace defective tube with National Electronics NL-84 (BLH# 137996-8) (same # for dummy zero tube).

IMPORTANT

THE BASES OF READOUT TUBES AND THE TUBE SOCKETS ARE NOT KEYED. IT IS POSSIBLE TO INSTALL A TUBE INCORRECTLY OR BACKWARDS. CHECK THAT NUMERALS ARE DIRECTLY TO THE FRONT BEFORE INSTALLATION.

5-34. LEGEND INDICATOR LAMP REPLACEMENT. Four (4) neon indicator lamps (ASA# A6A-BLH# 137994-8) are housed in the legend box assembly to the left of the most significant digital tube. The lamps indicate a positive or negative signal readout state, the legend, and the multiplier figure. The lamps are life rated for 25,000 hours and should not require frequent replacement. If replacement is necessary, remove the chassis to the extent described in Paragraph 5-33. The legend box assembly is a plug-in circuit mounted on the digital assembly board. Dismount by grasping the edges and pulling straight upward. Lamp replacement is as follows:

a. Unclip cover and window assembly from legend box.

b. Remove light diffuser lens over defective lamp.

c. Grasp one lead of the lamp with a pair of needle nose pliers.

d. Place a low heat (25 to 30 watts) small-tip soldering iron on either side of the board and pull up on the lead.

e. Clean component lead hole by heating the hole with the iron and inserting a wooden toothpick. Remove the toothpick after the solder has cooled.

f. Shape leads of new lamp with a bending fixture or a rounded plier jaw as shown in Figure 5-10 and insert them in lead holes.

CAUTION

IMPROPER BENDING OF THE LEADS CAN RESULT IN FRACTURE OF THE GLASS WHERE THE LEAD ENTERS THE PRESS AREA OF THE LAMP. BEND LEADS AROUND A CURVED SURFACE AT LEAST 1/8 INCH FROM THE GLASS.

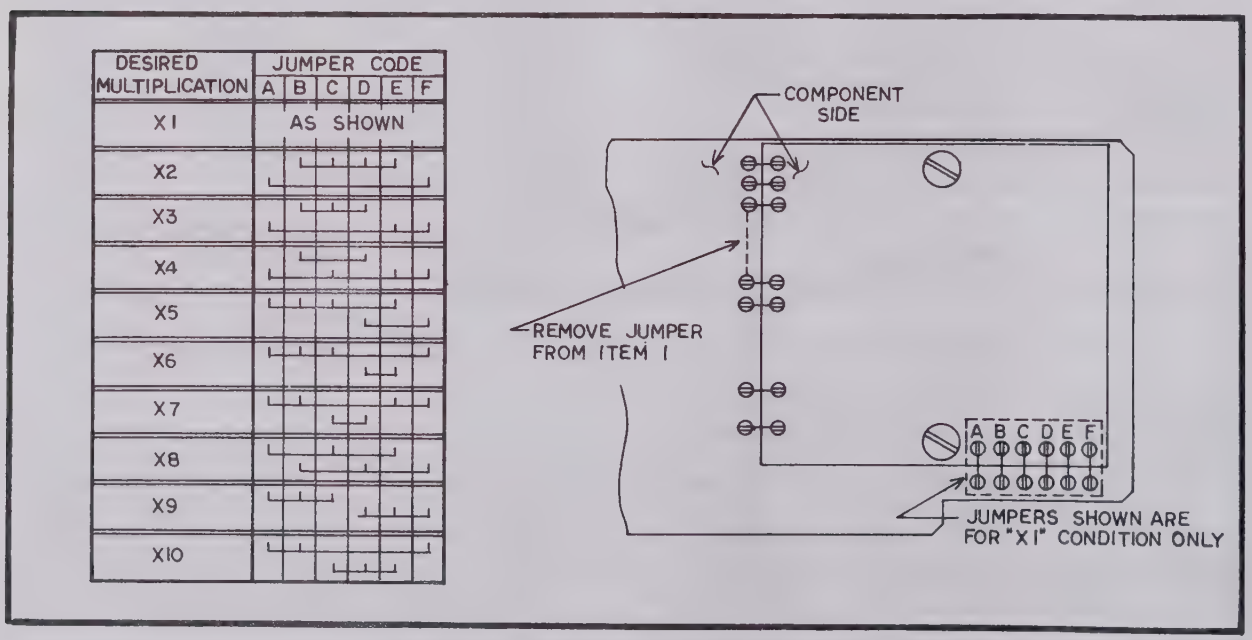


Figure 5-7. Multiplier Jumpering Sequence

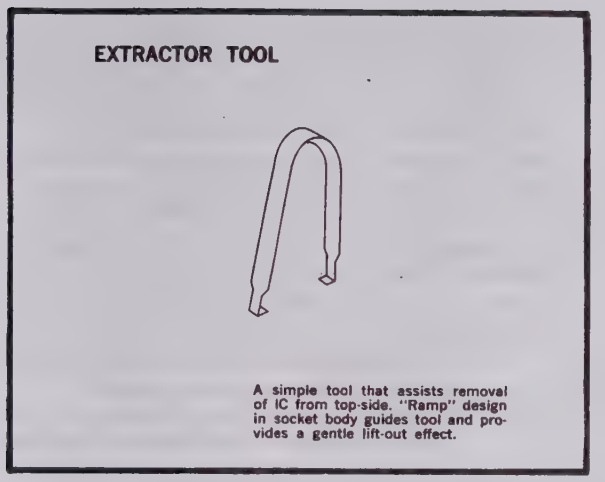

EXTRACTOR TOOL
A simple tool that assists removal of IC from top-side. "Ramp" design in socket body guides tool and provides a gentle lift-out effect.

Figure 5-8. Extractor Tool

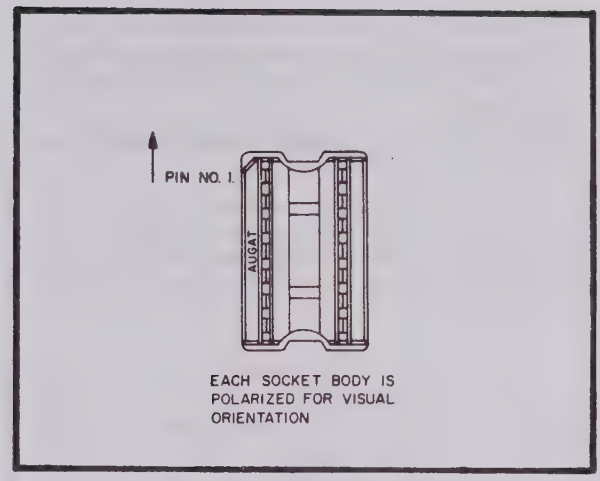


Figure 5-9. IC Polarity

g. Reheat with soldering iron and add a small amount of new 60/40 Rosin Core Solder (Fed. Spec. QQS 571C-Kester 44 or equiv.) as required to form a good electrical connection.

h. Clean excessive flux from the connection and adjoining area.

i. Replace diffuser lens, cover, and window assembly.

j. Plug legend box assembly into PC board and apply power to the instrument for test before reassembling chassis and case.

NOTE

Neon lamps of this type require a 24 hour burn in period before functioning to full capacity. During the burn in, the lamp will be lit to approximately 50% brilliance and the diminished glow will appear to "walk" the length of the two electrodes. The glow will eventually elongate and stabilize at the end of the burn in period.

5-35. SWITCH AND CONTROL REPLACEMENT. The pushbutton POWER and MODE switches must be replaced as complete assemblies. Refer to Figure 5-2, and proceed as follows:

a. Unplug instrument and disconnect all signal and power output connectors or cables.

b. Remove entire chassis from case as follows:

(1) Remove top cover (Paragraph 5-4).

(2) Locate and unscrew four (4) 8-32 x 1 1/4 BHMS, chassis retaining screws.

(3) Slide chassis completely out of case and place upright on an insulated surface.

c. Unscrew the top two front panel retaining nuts with a nutdriver.

d. Turn the chassis upside down and unscrew the two bottom 6-32 front panel retaining nuts with an open end wrench.

e. Turn instrument upright; locate and unscrew the adjustment bracket retaining screw holding the display board to the light shield (black enclosure surrounding display board).

f. Disconnect the display board from connector J8 and draw forward out of chassis.

g. Note color code and pin position of switch wiring, and unsolder wires.

h. Unscrew the two front switch assembly retaining screws holding the defective switch assembly to the subpanel.

i. Lift switch assembly out of subpanel notches.

Install the replacement switch assembly in reverse sequence.

NOTE

The calibration resistor (factory selected) is mounted across two pins on the MODE switch. If the MODE switch is replaced, reinstall the resistor on the new assembly. Recalibrate the instrument before returning to service. (see Paragraph 5-42).

5-36. With the exception of a few minor and easily recognized differences, the AMPL SPAN and BRIDGE ZERO potentiometers are replaced according to the procedure specified for switch replacement. Both controls are mounted on the panel subassembly and require the same degree of chassis

disassembly for removal and replacement. Because both controls are in the control and calibration circuit, the instrument must be recalibrated before operation.

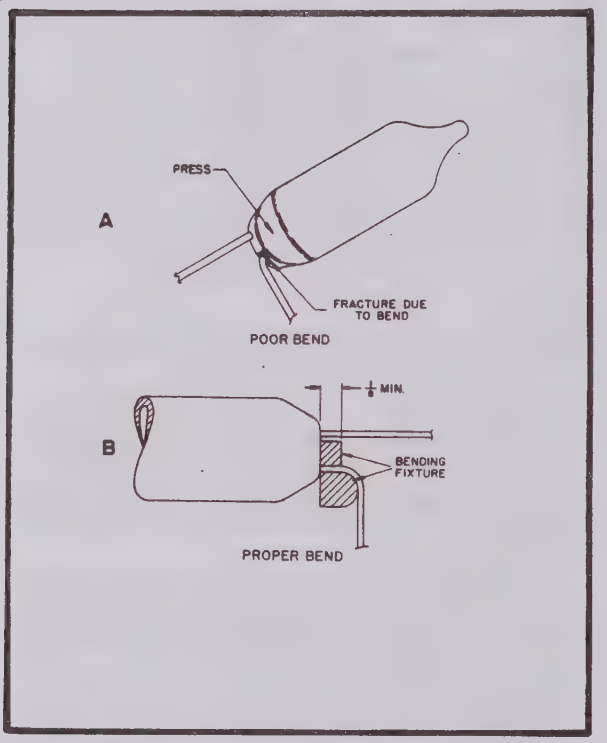


Figure 5-10. Bending Lamp Leads

5-37. FUSE REPLACEMENT. Electrically, the entire instrument forward of the input side of the line filter is protected by a 0.3A, 250V, time delay fuse. The fuse - the only one in the instrument - is designated F1 and is physically located in a fuse holder on the lower rear panel. Replace with BLH#128532-8 (Buss, MDL 0.3) after first determining and rectifying cause of overload.

5-38. TRANSFORMER REPLACEMENT. Transformer replacement is relatively simple and can be performed without removing the chassis from the instrument.

a. Slide top cover of instrument to rear (Paragraph 5-4).

b. Unplug PC boards adjacent to the transformer (+5V/180V P.S. and counter assembly) to allow working room and to reduce possibility of damage.

c. Tag each lead - both primary and secondary - with the corresponding transformer coil lead identification number.

d. Unsolder leads.

e. Remove transformer from chassis assembly by unscrewing two (2) 4-40 x 5/8 BHMS.

f. Replace transformer with BLH# 409044-1.

5-39. AC POWER CORD REPLACEMENT. The instrument is equipped with a six-foot, three-conductor power cable. When replacing, note lead connection points. The green lead is the ground lead and must be connected to the case. Removal and replacement of the power cable requires that the instrument chassis be removed from the case. The step by step replacement procedure is listed below:

a. Unplug instrument and disconnect all signal and power output connectors or cables.

b. Remove entire chassis from case as follows:

(1) Remove top cover (Paragraph 5-4).
(2) Locate and unscrew four (4) 8-32 x 1 1/4 BHMS. Chassis retaining screws.
(3) Slide chassis completely out of case and place upside down on an insulated surface.

c. Locate and unsolder the black lead from the fuse holder, white lead from phenolic solder lug terminal strip, and green ground lead from chassis ground lug.

d. Compress strain relief inside chassis with special tool if available or with pliers and push out of mounting hole.

e. Prepare new cable for installation (tin wires, etc).

f. Thread new cable through strain relief and reinstall in chassis. Leave approximately two inches of sheathed cable inside case in addition to the six inch lengths of stripped, tinned leads.

g. Press strain relief into mounting hole to secure.

h. Solder new cable to proper connection points.

5-40. Servicing PC Boards.

5-41. Excessive heat or pressure can lift the copper strip from the board. Avoid damage by using a low power soldering iron (50 watts maximum) and following these instructions. Copper that lifts off the board should be cemented in place with a quick-drying acetate base cement having good electrical insulating properties. A break in the copper should be repaired by soldering a short length of tinned copper wire across the break. Use only high quality rosin core solder when repairing etched circuit boards. NEVER USE PASTE FLUX. After soldering, clean off any excess flux and coat the repaired area with a high quality electrical varnish or lacquer.

5-42. CALIBRATION.

5-43. General.

5-44. The indicator measuring circuits contain both fixed and variable high-stability, precision wirewound resistors for long dependable service. Once adjusted, the indicator seldom requires recalibration. If, however, a component fails and is replaced or if, for other reasons the accuracy of the indicator is in doubt, the calibration should be checked and if necessary adjusted. Calibration Kits should be returned to BLH for repair and recalibration.

5-45. ADJUSTMENTS.

5-46. The following adjustments are for 8200 Indicators not being used in Calibration Kits. Adjustments directly affect the calibration of the 8200 and Calibration Kits should be recalibrated at BLH on a periodic basis, annually or semi-annually.

5-47. Power Supply Adjustment.

5-48. The voltage trim potentiometers are located on the +5V/+180V supply board and on the +10V/±15V board. Check voltages at the appropriate test point prior to making adjustments. Refer to Figure 5-2 for location of adjustments.

a. Connect a voltmeter (see Table 5-1) between the selected test point and chassis.

b. Rotate the corresponding adjusting potentiometer from one extreme position to the other several times to insure good slider contact.

c. Adjust for the specified voltage output. Note that the 180V output is unregulated and uncontrolled. This voltage may be as high as 200V unloaded. Check under load.

d. With test leads connected, alternately apply and remove a load to the instrument. The regulated outputs should not vary or fluctuate. If unable to adjust to specified level or if regulation is poor, check supply for defective components; if necessary, replace board.

5-49. Zero Adjustments.

5-50. Instrument zero is established by setting the zero controls (front panel and internal trims) back from the output through to the input. Refer to Figure 5-2 for control location.

a. Refer to Paragraph 5-55 and perform the converter adjust as described.

b. Press Mode ZERO switch.

c. Adjust R29 in the Preamplifier for 00000 indication on the readout.

d. Connect a zero input signal from a Model 625 Calibrator to the input of the 8200.

e. Press Mode OPR switch.

f. Adjust the front panel BRIDGE ZERO control for a 00000 indication.

g. Press Mode ZERO. Indicator should read 00000.

h. Alternately change the INPUT MV/V from 2.4 to 3.6. Indicator should read 00000.

i. If zero changes in step g or h, repeat entire process.

5-51. Span Adjustments.

5-52. The span adjustments in the following procedures will complete the calibration of the front panel controls so that span accuracy will be as stated in the specifications (Section I).

a. Press Mode ZERO switch. Indicator should read 00000. If not, refer to zero adjustments.

b. Press 2.4mV/V INPUT switch.

c. Press Mode CAL switch.

d. Adjust AMPL SPAN control so that Indicator reading agrees with the calibration figure for the cell being used. Refer to Table 3-1 in Section III.

e. Press 3.6mV/V INPUT switch. Reading should be 70% of that obtained for the 2.4mV/V INPUT.

Note: If the calibration readings have not been previously determined, log the readings in the Table (3-1) for future calibration checks. Calibration readings are determined only after linearity adjustments are completed.

5-53. Linearity Adjustments.

5-54. The following procedures apply to the front panel linearity control or to an external control connected to the appropriate pins of connector J1.

a. Apply power to Indicator and set zero controls for zero reading on the 8200.

b. Set LINEARITY control to midrange (500).

c. Dead weight load system to full scale and adjust span control for precise reading.

d. Return to zero load, then apply 50% of full scale and note reading. Difference between reading and actual load is linearity deviation.

e. Adjust the LINEARITY control for twice the deviation in the same direction, i.e., where observed deviation is -10 counts, adjust for -20; where deviation is +10 counts, adjust for +20.

f. Apply full scale load and readjust the span control for the precise reading.

g. Recheck the 50% loading point by returning to zero load and then up to the 50% point.

h. If deviation is still evident, correct LINEARITY adjustment is in step e, recycling the load from full scale to zero, to 50%, to full scale.

IMPORTANT: Internal linearity control R23 is locked in the clockwise direction so that the control is effectively out of the circuit and the front panel control (LINEARITY) is the only control in the circuit.

5-55. Converter Adjustment.

5-56. The following procedures are used to calibrate the converter section of the instrument independent of the input preamplifier and filter circuit.

a. Connect a voltage standard (Analogic #AN3100 or equivalent) to pins 1 (+) and 35 (dc common) at rear panel connector J1.

b. Set voltage standard to +1mV.

c. Adjust zero control (R42) on the converter board until display indicates 1 count.

d. Set voltage standard to positive full scale voltage (+10,000Vdc).

e. Adjust the +FS control R33 on the converter board until display indicates +10,000 counts.

f. Set voltage standard to negative full scale voltage (-10,000Vdc).

g. Adjust the -FS control R35 until digital display indicates negative full scale (-10,000 counts).

5-57. Common Mode Rejection Adjustment.

5-58. The final adjustment to be made in the 8200 is the COMMON MODE REJECTION adjustment (R2) in the preamplifier so that the preamplifier will reject signals that are common to both inputs, such as capacitive pickup in signal cables.

a. Connect a Model 625 Calibrator to the input of the 8200 at TB1 as shown in Figure 5-11. Connections are made color for color with both red and white wires from the 8200 connected to the white jack on the 625. This wiring setup will apply 5V as common mode signal to the input circuit.

b. Observe the reading at the digital indicator.

c. Remove the GREEN lead at the 625 and again note the reading.

d. Repeatedly remove and replace the GREEN lead at the 625 and adjust R2 on the preamplifier board until the Indicator reads exactly the same with and without the GREEN lead connected.

f. Remove test setup.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for identifying and ordering replacement parts. An overall schematic diagram of the instrument and parts locator (reverse side) is included at the back of this manual. Table 6-1 lists in alphanumeric order by reference designator and provides the following information on each part:

a. BLH part number.

b. Total quantity used in the instrument (TQ column). Quantity listed where item first appears on list.

c. Recommended spares for year application in a remote location (or 2000 hours). (RS column)

6-3. ORDERING INFORMATION.

6-4. To obtain replacement parts, address order or inquiry for parts to the nearest BLH Sales/Service Office (see list at rear of this manual) or direct to BLH. Identify parts by BLH part number.

a. Model number of instrument.

b. Serial number of the unit.

c. Description of the part including function and location.

DESIGNATORS

A	= assembly	F	= fuse	P	= plug	TC	= thermocouple
B	= motor	FL	= filter	Q	= transistor	V	= vacuum tube, neon bulb, photocell etc.
BT	= battery	HR	= heater	QCR	= transistor-diode		
C	= capacitor	J	= jack	R	= resistor	W	= cable
CR	= diode	K	= relay	RT	= thermistor	X	= socket
DL	= delay line	L	= inductor	S	= switch	XDS	= lampholder
DS	= lamp	M	= meter	T	= transformer	XF	= fuseholder
E	= misc electronic part	MP	= mechanical part	TB	= terminal board	Z	= network

ABBREVIATIONS

A	= ampere (s)	H	= henry (ies)	nA	= nanoampere (s) = 10^{-9}	Se	= selenium
Ag	= silver	Hg	= mercury	NC	= normally closed	sect	= section (s)
Al	= aluminum	Hz	= cycles per second	Ne	= neon	Si	= silicon
Au	= gold			NO	= normally open	sl	= slide
		ID	= inside diameter	NPO	= negative positive zero (zero temperature coefficient)	SPDT	= single-pole double-throw
C	= capacitor	impg	= impregnated			SPST	= single-pole single-throw
cer	= ceramic	incd	= incandescent	ns	= nanosecond (s) = 10^{-9}		
coef	= coefficient	ins	= insulation (ed)			Ta	= tantalum
com	= common			Ω	= ohm (s)	tog	= toggle
comp	= composition	KΩ	= kilohm (s) = 10^{+3}	OD	= outside diameter	tol	= tolerance
conn	= connection	kg	= kilogram			trim	= trimmer
		KHz	= kilocycle (s) = 10^{+3}	p	= peak	TSTR	= transistor
dep	= deposited			pc	= printed circuit		
DPDT	= double-pole double-throw	L	= indicator	pF	= picofarad (s) = 10^{-12}	V	= volt (s)
		lin	= linear taper	piv	= peak inverse voltage	vacw	= alternating current working volt (s)
DPST	= double-pole single-throw	log	= logarithmetic taper	p/o	= part of	var	= variable
		m	= milli = 10^{-3}	pos	= position (s)	vdcw	= direct current working volt (s)
elect	= electrolytic	mA	= milliampere (s) = 10^{-3}	poly	= polystyrene		
encap	= encapsulated	mH	= millihenry (s) = 10^{-3}	pot	= potentiometer	W	= watt (s)
		MHz	= megacycle (s) = 10^{+6}	p-p	= peak-to-peak	w/	= with
F	= farad (s)	MΩ	= megohm (s) = 10^{+6}	prec	= precision (temperature coefficient, long term stability, and/or tolerance.)	w/o	= without
FET	= field effect transistor	met flm	= metal film			ww	= wirewound
fxd	= fixed	mfr	= manufacturer				
		mtg	= mounting	R	= resistor	*	= optimum value selected at factory, average value shown (part may be omitted)
GaAs	= gallium arsenide	μ	= micro = 10^{-6}	rms	= root-mean-square		
GHz	= gigacycle (s) = 10^{+9}	my	= Mylar®	rot	= rotary		
gd	= guard						
Ge	= germanium						
grd	= ground (ed)						

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Table 6-1. Replaceable Parts

Ref Desig	BLH Part No.	RS	TQ	Description	Mfr	Mfr Part No.
END ITEM	412651-4			Model 8200 Calibration Indicator		
A1	410552-4		1	Assembly, Chassis		
A2	412660-2		1	Assembly, Front Sub-Panel		
A3	412496-3		1	Assembly, 5-Digit Display		
A4	412504-2		1	Assembly, Legend Box		
A5	409725-3		1	Assembly, Analogic Counter		
A6	409776-2		1	Assembly, +5/+180V Power Supply		
A6A1	409722-2		1	Assembly, Pulse Multiplier		
A7	409780-2		1	Assembly, ±15V Power Supply		
A8	412212-1		1	Assembly, Analogic Converter		
A9	411154-2		1	Assembly, Active Filter (optional)		
A10	409784-2		1	Assembly, Preamplifier		
A11	411621-2		1	Assembly, Extender Board		
A12	412369-2		1	Assembly, Resistor Board		
A1	410552-4		1	Assembly, Chassis		
A1C1	141905-8		1	C: 0.1μF, 1KV, Filter		
A1J2-J7	137384-8		6	Conn: 22-Pin		
J8	137420-8		1	Conn: 22-Pin (part of harness)		
A1L1	136731-8		2	Choke: 680μH, Filter		
L2				Same as L1		
A1MP1	412568-1		1	Window Assembly		
MP2	412432-1		4	PC Board Guide		
MP3	410486-1		8	PC Board Guide		
MP4	410906-1		1	Bracket, Filter		
MP5	412213-1		12	Sprint, Hold-down		
MP6	412392-3		1	Panel, Front		
MP7	410723-3		1	Chassis		
MP8	138261-8		1	Knob: Multiplier Switch		
A1Q1	137785-8		1	Scon: Transistor PNP 2N1168		
Q2	137824-8		1	Scon: Transistor NPN TIP-29A		
	137045-8		1	Heat Sink, P/O Q2		
A1R3	135594-8		1	R: Var 100K		
	141545-8		1	Duo-Dial, P/O R3		
A1S4	415467-2		1	Switch: MULTIPLIER		
A1T1	409044-1		1	Transformer: Power		
	415012-1		1	Brace T1 Mounting		
A1W1	409549-1		1	Line Cord		
A1A1	412649-2		1	Assembly, Rear Panel		
A1A1F1	128552-8		1	Fuse: 0.3A, SloBlo		
A1A1J1	137405-8		2	Conn: 37-pin (part of harness)		
J9				Same as J1		
J10	131810-8		1	Conn: 8-Pin		
A1A1MP1	412650-2		1	Panel-Rear		
A1A1TB1	138407-8		1	Terminal Strip, 7-Position		
A1A1XF1	131050-8		1	Fuseholder, F1		

Table 6-1. Replaceable Parts

Ref Desig	BLH Part No.	RS	TQ	Description	Mfr	Mfr Part No.
A2	412660-2		1	Assembly, Front Sub-Panel		
A2MP1	412390-3		1	Sub-Panel		
A2R1	410946-1		2	R: Var 20K		
R2				Same as R1		
A2S1	413955-1		2	Switch: 2-Section Pushbutton		
S2	413957-1		1	Switch: 3-Section Pushbutton		
S3				Same as S1		
	137400-8		4	Pushbutton RED		
	137401-8		3	Pushbutton BLACK		
A3	412496-3		1	Assembly, 5-Digit Display		
	412497-3			Assembly, 6-Digit Display		
A3A1	412264-2		1	Assembly, Display PC Board		
A3MP1	412495-3		1	Bracket, Assembly Mounting		
MP2	412498-1		AR	Bracket, PC Board Mounting		
A3V1-V5	137996-8		5	Tube, Nixe (5-digit display)		
V6			1	Same as V1 (6-digit display)		
A3A1	412264-2		1	Assembly, PC Board		
	412265-2		1	PC Board		
A3A1C1	137988-8		1	C: 15μF, 10V		
A3A1CR1-CR11	137989-9		11	Scon:Diode 1N4143 (CR3 Optional)		
A3A1IC1-IC5	137984-8		5	Scon: Integrated Circuit SN744IN		
A3A1Q1-Q9	137990-8		9	Scon: Transistor 2N4410 (Q3 Optional)		
A3A1R1	127238-8		4	R: FXD, 47K, 1/2W, 10%		
R2	137987-8		6	R: FXD, 8.2K, 1/4W, 5%		
R3				Same as R2		
R4				Same as R2		
R5				Same as R2		
R6				Same as R2		
R7				Same as R2		
R8				Same as R1		
R9				Same as R1		
R10				Same as R1		
R11	137986-8		9	R: FXD, 20K, 1/8W, 5%		
R12	137985-8		1	R: FXD, 5.1K, 1/3W, 5%		
R13-R21				Same as R11 (R14 Optional)		
A3A1XIC1-XIC5	137983-8		5	Socket, Integrated Circuit		
A3A1XV1-XV6	137982-8		6	Socket, Nixie Tube		

Table 6-1. Replaceable Parts

Ref Desig	BLH Part No.	RS	TQ	Description	Mfr	Mfr Part No.
A4	412504-2		1	Assembly, Legend Box		
A4DS1-DS4	137994-8		4	Lamp		
A4MP1	412298-2		1	PC Board		
MP2	410966-2		1	Legend Box		
MP3	412507-1		1	Cushion		
MP4	410981-1		3	Divider		
MP5	412506-1		4	Lens		
MP6	410967-1		1	Cover		
MP7			1	Legend (as ordered)		
MP8	137998-8		2	Guide Socket		
MP9	137997-8		6	PC Contacts		
A5	409725-3		1	Assembly, Decade Counter		
A5MP1	410845-3		1	PC Board		
A5C1	EG10-156-10		1	C: 15μF, ±10%, 10V (analogic)		
A5IC1	46A901659X		1	Scon: Integrated Circuit (Fairchild)		
IC2-IC6	SN7475		5	Scon: Integrated Circuit (Texas In.)		
IC7	SW708		1	Scon: Integrated Circuit (Stewart-Warner)		
IC8-IC12	SN7490		5	Scon: Integrated Circuit (Texas Inst.)		
A5Q1	137800-8		1	Scon: Transistor NPN 2N3904		
A5R1			1	R: FXD, 5.1K, 5%, 1/4W, CC		
R2			3	R: FXD, 470Ω, 5%, 1/4W, CC		
R3	137813-8		1	R: FXD, 1K, 5%, 1/4W, CC		
R4	137734-8		1	R: FXD, 270Ω, 5%, 1/4W, CC		
R5-R6				Same as R2		
A5XIC1-XIC12	137983-8		12	Sockets, Integrated Circuit		
A6	409776-2		1	Assembly, +5V/+180V Power Supply		
	409777-2		1	PC Board		
A6C1	137793-8		1	C: 4μF, 250V		
C2	137794-8		1	C: 2000μF, 15V		
C3	137795-8		1	C: .047		
C4	137796-8		1	C: 1μF, 15V		
A6CR1	137797-8		1	Scon: Quad Diode VE48		
CR2	137798-8		1	Scon: Dual Diode VE18		
A6IC1	137799-8		1	Scon: Integrated Circuit μA723		
	137801-8		1	Heat Sink (IC1)		
A6Q1	137800-8		2	Scon: Transistor NPN 2N3904		
Q2				Same as Q1		
A6R1	127100-8		1	R: FXD, 33Ω, 1/2W, CC, 10%		
R2	137790-8		2	R: FXD, 390K, 1/4W, CC, 10%		
R3	132364-8		1	R: FXD, 180Ω, 2W, CC, 10%		
R4	140849-8		1	R: FXD, 1.5K, 1/4W, CF, 1%		
R5	137789-8		1	R: Variable, 1K		
R6	137788-8		1	R: FXD, 4.5K, 1/4W, CF, 1%		
R7	137792-8		1	R: FXD, 0.7Ω, 1W, WW, 5%		
R8	137729-8		4	R: FXD, 1K, 1/4W, CC, 5%		
R10-R11				Same as R8		
R12				Same as R2		

Table 6-1. Replaceable Parts

Ref Desig	BLH Part No.	RS	TQ	Description	Mfr	Mfr Part No.
A6A1	409772-2		1	Assembly, Pulse Multiplier		
	409773-2		1	PC Board		
A6A1C1	137735-8		1	C: 25μF, 15V		
C2	137826-8		2	C: .25μF, 10V		
C3	137737-8		1	C: 91pF, 300V		
C4	137827-8		1	C: 68pF, 300V		
C5				Same as C2		
C6	137738-8		1	C: 150pF, 300V		
A6A1CR1	137739-8		3	Scon: Diode IN914		
CR2				Same as CR1		
CR3				Same as CR1		
A6A1IC1	137740-8		1	Scon: Integrated Circuit SN745IN		
IC2	137741-8		1	Scon: Integrated Circuit MC817P		
IC3	137742-8		1	Scon: Integrated Circuit DM8510N		
IC4	137828-8		1	Scon: Integrated Circuit U8A991428X		
IC5	137744-8		1	Scon: Integrated Circuit DM8520		
A6A1Q1	137800-8		1	Scon: Transistor NPN 2N3904		
A6A1R1	137729-8		2	R: FXD 1K, 1/4W, 5%		
R2	137730-8		1	R: FXD 7.5K, 1/4W, 5%		
R3	137731-8		2	R: FXD 3.9K, 1/4W, 5%		
R4				NOT USED		
R5				Same as R3		
R6	137732-8		1	R: FXD, 4.7K, 1/4W, 5%		
R7				Same as R1		
R8	137733-8		2	R: FXD, 10K, 1/4W, 5%		
R9				Same as R8		
R10	137734-8		1	R: FXD, 270Ω, 1/4W, 5%		
A6A1XIC1	137983-8		5	Socket, Integrated Circuit		
XIC2				Same as XIC1		
XIC3				Same as XIC1		
XIC4				Same as XIC1		
XIC5				Same as XIC1		
A7	409780-2		1	Assembly, ± 15V Power Supply		
	409781-2		1	PC Board		
A7C1	137819-8		1	C: 1200μF, 25V		
C2	137820-8		1	C: 350μF, 35V		
C3	137822-8		1	C: 500pF, 300V		
C4	137978-8		1	C: 1000pF, 300V		
C5	137821-8		1	C: 100pF, 300V		
C6	137811-8		1	C: .01μ , 25V		
A7CR1	137808-8		1	Scon: Diode, Zener 6.2V, IN5234		
CR2	137798-8		1	Scon: Diode, Bridge VE18		
A7IC1	137799-8		3	Scon: Integrated Circuit μA723		
	137801-8		3	Heat Sink, Integrated Circuit		
A7Q1	137824-8		1	Scon: Transistor NPN TIP29A		
Q2	137825-8		1	Scon: Transistor PNP TIP30A		
Q3				NOT USED		
Q4	142099-8		1	Scon: Transistor PNP 2N3638		
	137045-8		2	Heat Sink, Q1, Q2		

Table 6-1. Replaceable Parts

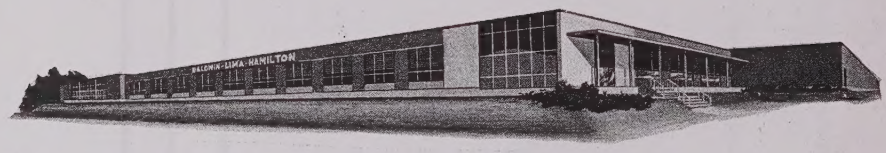
Ref Desig	BLH Part No.	RS	TQ	Description	Mfr	Mfr Part No.
A7R1	140856-8		4	R: FXD 3K, 1/4W, 1%, CF		
R2	137812-8		3	R: Variable 1K		
R3				Same as R1		
R4	137809-8		1	R: FXD 5.5K, 1/4W, 1%, WW		
R5	Same as R			Same as R2		
R6	137975-8		1	R: FXD 1.8K, 1/4W, 1%, WW		
R7	137813-8		1	R: FXD, 1K, 1/4W, 5% CC		
R8	137817-8		1	R: FXD, 8.5K, 1/4W 1% CF		
R9				Same as R1		
R10				Same as R2		
R11				Same as R1		
R12	137818-8		1	R: FXD, 2.5K, 1/4W. 1%, CF		
R13	137814-8		1	R: FXD 2K, 1/4W, 5%, CC		
R14				NOT USED		
R15	137973-8		2	R: FXD 3.9Ω, 1/2W, 5% CC		
R16				Same as R15		
R17	137816-8		1	R:FXD 1Ω, 1W, 5%, WW		
R18	137815-8		1	R: FXD 100K, 1/4W, 5%, CC		
R19	140852-8		1	R: FXD 2K, 1/4W, 1%, CF		
R20			1	R: FXD Select, 1/4W, 1%, CF		
A8	412212-1		1	Assembly, Converter		
A9	411154-2		1	Assembly, Active Filter (optional)		
	411155-2		1	PC Board		
A9C1	137834-8		1	C: 47pF		
C2-C4	137837-8		3	C: .47μF, 50V (poly-C)		
A9CR1	137739-8		1	Scon: Diode IN914		
A9IC1	137908-8		1	Scon: Integrated Circuit μA741		
A9Q1	137830-8		1	Scon: Transistor H1899E		
Q2	137854-8		1	Scon: Transistor H232		
A9R1 -R3	127241-8		3	R: FXD, 1/2W, 10%, 82K		
R4-R5	140895-8		2	R: FXD 120K, 1/4W, 1%, CF		
R6	127234-8		1	R: FXD 22K, 1/2W, 10%,		
R7	127247-8		1	R: FXD, 270K, 1/2W, 10%,		
R8	137911-8		1	R: Variable, 10K		
A10	409784-2		1	Assembly, Preamp/Switches		
	409785-2		1	PC Board		
A10C1-C3	137834-8		3	C:47pF, 500V		
C4	137833-8		2	C:30pF, 500V		
C5-C6	141988-8		4	C: .1μF, 100V		
C7	137837-8		1	C: .47μF, 50V		
C8				NOT USED		
C9-10				Same as C5		
C11	137836-8		1	C: .01μF, 200V		
C12	137853-8		1	C: .47μF		
C13-14	137838-8		2	C: 3μF, 25V		
C15				Same as C4		
C16-17	137974-8		2	C: .047μF, 50V		
C18-19	134135-8		2	C: .1μF, 100V		
A10CR1	137739-8		2	Scon: Diode IN914		
CR2-3	137976-8		2	Scon: Diode FD300		
CR4	137832-8		1	Scon: Diode Zener IN5234B		
CR5				NOT USED		

Table 6-1. Replaceable Parts

Ref Desig	BLH Part No.	RS	TQ	Description	Mfr	Mfr Part No.
A10 CR6				Same as CR1		
A10IC1	137852-8		2	Scon: Integrated Circuit LM301A		
IC2				Same as IC1		
A10L1	137905-8		2	Choke, 100μH		
L2				Same as L1		
A10MP1	137829-8		1	Link, Thermal (Q8, Q9)		
MP2	411031-1		1	Shield, PC Board		
A10Q1	410603-1		1	Scon: Transistor, Dual NPN		
Q2	278512-1		1	Scon: Transistor, NPN A642L		
Q3-Q4	403443-1		2	Scon: Transistor, NPN, A641 (matched pr)		
Q5-Q6	137800-8		2	Scon: Transistor, NPN 2N3904		
Q7	137830-8		1	Scon: Transistor, FET, U1899E		
Q8-Q9	412068-1		2	Scon: Transistor, FET, U1899E(Matched pr		
Q10	137972-8		1	Scon: Transistor, FET, U61764		
Q11	137854-8		1	Scon: Transistor, FET U232		
A10R1	138203-8		1	R:FXD, 56K, 1/4W, 10% CC		
R2	137841-8		3	R: Variable 20K		
R3				NOT USED		
R4	137845-8		1	R: FXD, 200K, 1/4W, .5%, WW		
R5	137846-8		1	R: FXD, 190K, 1/4W, .5%, WW		
R6	*		1	R: Select, WW		
R7-R8	140910-8		2	R: FXD, 500K, 1/4W, 1%, CF		
R9	140893-8		4	R: FXD, 100K, 1/4W, 1%, CF		
R10	*		1	R: Select WW		
R11	*		1	R: Select WW		
R12	137847-8		2	R: FXD, 5K, 1/4W, .5%, WW		
R13				Same as R12		
R14				NOT USED		
R15	*		1	R: Select, WW		
R16				Same as R9		
R17	140852-8		1	R: FXD, 2K, 1/4W, 1%, CF		
R18	137844-8		1	R: FXD, 33.5K, 1/4W, 1%, CF		
R19	140880-8		1	R: FXD, 30K, 1/4W, 1%, CF		
R20				Same as R9		
R21				Same as R9		
R22	138230-8		1	R: FXD, 10M, 1/4W, 10%, CC		
R23				NOT USED		
R24	140895-8		2	R: FXD, 120K, 1/4W, 1%, CF		
R25				Same as R24		
R26	138198-8		2	R: FXD, 22K, 1/4W, 10%, CF		
R27	135486-8		1	R: FXD, 100K, 1/3W, .5%, WW		
R28	138226-8		1	R: FXD, 4.7M, 1/4W, 10%, CC		
R29				Same as R2		
R30				Same as R26		
R31	138206-8		2	R: FXD, 100K, 1/4W, 10%, CC		
R32	138194-8		3	R: FXD, 10K. 1/4W, 10%, CC		
R33				Same as R31		
R34				Same as R32		
R35				Same as R32		
R36				NOT USED		
R37	*		1	R: Select		
A10RX1	*		3	R: Select, 1/4W, 1%, CF		
RX2				Same as RX1		
RX3				Same as RX1		

Table 6-1. Replaceable Parts

Ref Desig	BLH Part No.	RS	TQ	Description	Mfr	Mfr Part No.
A11	411621-2		1	Assembly, Extender Board		
A12	412369-2		1	Assembly, Resistor Board		
	412367-2		1	PC Board		
A12R1				NOT USED		
R2				NOT USED		
R3				NOT USED		
R4			2	R: 175Ω, 1/4W, WW, ± .1%	15909	Daven 1281
R5				Same as R4		
R6	134067-8		3	R: 70.2K, 1/4W, WW, 1%	15909	Daven 1281
R7				Same as R6		
R8	135485-8		2	R: 10K, 1/4W, WW, .1%	15909	Daven 1281
R9				Same as R8		
R10				NOT USED		
R11				NOT USED		
R12				Same as R6		
R13			1	R: 57K, 1/4W, WW, .5%	15909	Daven 1281
R14-20				NOT USED		



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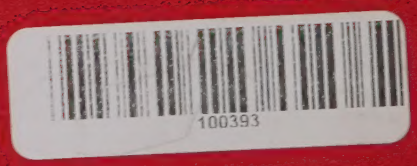
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